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Advertisement Index, see page xxviii.

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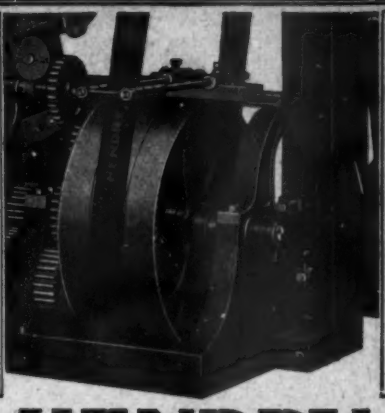

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Vol. LXXXII.] CONTENTS: January 18, 1918. [No. 2,095.

	Page
Economic Problems	49
The Whitley Recommendations: a Matter of Urgency ...	50
Reminiscences.—III., by "Ex-Shift Dog"	51
Cable Fault Localisation in Practice, by D. M. W. Hutchison (*illus.*)	52
Iron Commutators, by F. Murgatroyd	54
Correspondence—	
Meters on a Changed Frequency	55
Illuminating Engineering	55
Distinctive Colours for Braided Cables	55
West of Scotland Linking-up (*illus.*)	56
New Electrical Devices, Fittings and Plant (*illus.*)	57
The French Bauxite and Aluminium Industry	58
War Items	58
Legal	59
Business Notes	59
Notes	63
City Notes	67
Stocks and Shares	67
Electric Tramway and Railway Traffic Returns	68
Market Quotations	68
Electrical Signalling and Control on Railways, by C. M. Jacobs (*illus.*)	69
New Zealand Water-Power Reports	70
Electrical Manufacturing in Australia	71
Gas Firing Boilers	72
New Patents Applied for, 1917	72
Abstracts of Published Specifications	72
Contractors' Column ... ...Advertisement page xxii	

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ECONOMIC PROBLEMS.

DURING the past few weeks the greater part of the world has been discussing momentous utterances by leading Statesmen who have laid down the terms on which they would be prepared to discuss Peace. These statements will be regarded as superseding others that preceded them, and they will probably form the basis upon which much discussion will take place in days to come. The average lay mind is not privileged to know what may be taking place in diplomatic circles, but from enemy Press utterances it appears unlikely that these speeches will have an immediate effect in bringing about actual negotiations, though ultimately it may be found that they have contributed to that end. One important outcome, however, and probably one of several that they were intended to produce, has been the re-establishing of a strong unity of aim and effort among our own and Allied peoples. The strain of war is unquestionably heavy—critically so—upon all the peoples of Europe, yet, notwithstanding this circumstance, the enemy cannot fail to be impressed by the new reinforcement of strength that has come to the Allies from such a spirit of unity. But the unity has to find expression in the carrying into effect of new measures which make a further call upon the man-power resources of the United Kingdom, and impose new restrictions upon industry. The conferences with Labour which made the occasion for the Premier's considered speech, have extended over the past ten days, and they still continue; it is to be hoped that what is required will be made possible with a minimum of friction, notwithstanding the present obnoxious attitude of the A.S.E. Yet we cannot fail to bear in mind that even if Labour concedes all that is hoped for from these conferences, and finds the men asked for, Industry will need to adapt itself with the greatest possible care to the conditions that will follow if we are to avoid evil effects upon the revenue-producing industries of the country. The need for a strengthening of the Forces is, of course, paramount, whether the remaining stages involve more heavy fighting, as seems at the moment inevitable, or whether months are spent

in preliminary and actual negotiations. In addition to the maintenance of the fighting forces at their maximum possible strength, we have also to bring together a new army of men to accelerate our rate of shipbuilding. To build new ships with utmost speed now is to help defeat the submarine devilry of the enemy, but it is also a measure of utmost importance which will ensure that ships shall be available in great numbers for urgent mercantile purposes when the war ends. Therefore, this new demand has to be made upon Industry and Labour to find many thousands of men to accelerate the carrying out of the great shipbuilding programme.

While we are thus compelled to centre our best energies upon a continuation of the struggle with all the means at our disposal, there are certain war questions other than man-power and shipbuilding which necessarily claim very serious thought after three and a half years of terribly wasteful war. The financial burden of conducting operations on so vast a scale is becoming an ever-increasing anxiety in most of the lands that are involved in hostilities. There has been no dramatic crash anywhere such as might have been anticipated, though we are more or less in the dark as to what is actually the state of affairs in Russia. But though there has been no sensational event of that kind, there can be no question that the financial problems for all the nations in the coming days will be of such a character that the old methods of dealing with such matters will not suffice. Expert authorities are coming forward with suggestions regarding what we may have to do in order to pay the interest on our heavy load of war debt, and to reduce the debt itself.

Taxation, as we know it, seems to have practically reached the limit, though Labour has advanced some sweeping proposals in that connection. It is impossible to go on taxing capital, however invested or held, up to the hilt, without injuring industry, by which we live. Much has been said concerning "Conscription of Capital." If that means what we think it means, it is inconceivable to contemplate prosperity of industry, and therefore plenty of work for everybody, after such procedure. Those who are putting their money into War Loans do so because they have the credit of the British nation to depend upon. Industry will be imperilled, in many cases actually confiscated out of existence, if we confiscate its capital, and such a shaking will have been given to the foundations of British credit as will prevent it from recovering its equilibrium for many a year.

Where, then, is the money to come from to meet the increasing financial burden? We are constantly being advised that when we come to the great task of re-establishing our pre-war industries and our foreign trade we shall need the fullest co-operation of the forces of Capital and Labour, and the assistance, in certain ways, of the State. As a matter of fact, something more will be needed. Beyond the increased productivity that such co-operation should assure, we shall require to adopt large ideas for the increase of wealth by the enterprising utilisation of the vast resources of the Empire, and by aiding certain Allied nations to develop their own resources for their own and for world benefit. Conscription of existing wealth would not only undermine national credit, it would jeopardise industry, lessening revenue instead of permanently relieving our burdens. What seems to be one of the urgent necessities of the moment is for the recommendations of the Empire Resources Development Committee, as set forth in the report issued last year, to be carried into effect with the utmost reasonable expedition. In an address to the Royal Colonial Institute last week, Mr. H. Wilson Fox, M.P., discussed some of those recommendations. He was speaking on "The Payment of War Debt by Development of Empire Resources." He estimated that the post-war revenue that the Government would have to raise to meet its obligations could not be less than £600,000,000 per annum, and some new method of raising the money would have to be found. He opined that taxation of imports was unlikely to yield any sum that would go far to meet our needs, and expressed the view that the burden of income-tax could not be increased indefinitely, while the conscription of existing wealth would be a dangerous and impracticable expedient. New wealth, he went on to say, must be produced under conditions which would assure to the State itself the direct receipt of a substantial share of the profits earned. Such a means was to be found in the adoption of the recommendations of the Empire Resources Development Committee.

The reports that have been put before us all during the past decade concerning the potential wealth of some of the British Colonies and Dependencies have read more like fairy tales than as business documents, so vast have been the possibilities that they have unfolded before us. The time is coming when probably some of the dreams which under normal conditions seemed unlikely to emerge into actualities may assume definite form under the conditions that will in the near future confront us. It may be that, notwithstanding the availability of demobilised forces, the need for larger population will hamper the Colonies in the fuller development of their resources, as it has done in the past. It may even be that what has been happening behind the lines in France will repeat itself in the future wealth creation of the world. Barriers of race and colour may be broken down, and labour armies of all nationalities may be utilised on great development projects to help to relieve the economic burdens of all after the war.

Our own Statesmen and the President of the United States have laid it down emphatically in their recent speeches that there will be no economic war after the war, though, as a war measure, such is necessary and justifiable. Possibly there may yet be co-operation of all democratic nations in the general development of the world resources for the benefit of the people of all lands. Sir A. Steel Maitland, however, does not appear to see any immediate prospect of such co-operation. In his speech of Tuesday last he warned an audience of business men that competition after the war would be keener than we had ever known it.

The Whitley Recommendations: A Matter of Urgency.

DR. ADDISON last week referred to the urgent need that exists for more speedy progress being made with the formation of Industrial Councils, as recommended in the Whitley Report. It is now getting on for a year since the conclusions of the Whitley Committee were arrived at, and we are

convinced that a number of Labour troubles that have developed since then might have been prevented if there had existed suitable machinery for dealing with the causes of friction before disagreement had reached a critical stage. There seems to have been most regrettable delay somewhere in applying the principles laid down. We are not overlooking the fact that the difficulties of the times are so great that it is not as easy as it might be in normal times to establish new organisations in which varied interests are concerned. We are aware, also, that in some works, arrangements already exist which provide very well for the maintenance of good relations between employer and employed. Further still, we know that there is a very truculent element in the country which pours scorn upon the Whitley idea, and means to oppose its application tooth and nail, because it wants Labour absolutely to control industry, and therefore despises suggestions for the establishment of good relations. The difficulties of the times, however, are in some respects an argument on the side of urgency, and no stone should be left unturned to secure harmonious working for the remainder of the war, as well as after it. The satisfactory experience of some manufacturers with their own arrangements is also an argument in favour of the Whitley spirit and its wider application along properly ordered lines. The opposition of the obstructive element, while it cannot be ignored, must not be treated too seriously, because we believe that when Labour as a body properly understands the proposals, the majority of its supporters have the good sense to see that along these lines, rather than by the pursuit of ideals in the deplorable Russian fashion, order, harmony, and prosperity are to be found for millions of our toilers. Dr. Addison, as Minister of Reconstruction, occupied as he is with a hundred enterprising proposals for paving the way to prosperity in the years of Peace, appreciates the urgency of the application of the Industrial Council idea in the interests of industries. Though we are calling up nearly half a million more men, we need to be prepared for "the dislocation which would arise on the proclamation of Peace, or even the declaration of an armistice." Organised associations of employers and employed will be essential in order that the Government may be able to confer with the industries on the many problems that will be bound to arise. Dr. Addison was speaking at a meeting at Stoke-on-Trent of the first National Industrial Council so far organised; it is concerned with the pottery industry. We hope that his appeal for greater expedition will not pass unheeded, though we recognise that there is still a great deal of ignorance upon the part of the public as to what the Whitley recommendations are. There is urgent need for propaganda work—making these things better known throughout the length and breadth of the land. The scarcity of paper prevents the newspapers from printing all that they would have published under normal conditions about this and many other matters. Everybody is too busy to read much, even if it were published. War news is about all that the average newspaper reader is interested in at present. It is unfortunate for the movement that these things should be so, for, in our opinion, they are a very real handicap. The recently formed Industrial Reconstruction Council has an important popularising duty lying before it, and we have every hope that it will soon be able to do useful work assisting the more expeditious application of the Whitley recommendations as urged by Dr. Addison.

REMINISCENCES.—III.

By "EX-SHIFT DOG."

SHIFT work in power stations is not often fraught with exhilarating experiences, and memories are more often of exciting and sad occurrences, and of regrettable visits to "the carpet" in the Chief's office; nevertheless, more than once such frivolities as tea parties have been successfully organised upon quiet Sunday or other afternoons, and similar innocent diversions can be recalled by most shiftmen of lengthy experience. Unfortunately, the topography and neighbourhood of the majority of stations do not favour the arrival and departure of guests, and usually one must, therefore, be content with the company of one's technical associates, some of whom do not constitute ideal companions. However, taken as a class, the technical personnel of English power stations is of good social standing and of decent antecedents. Company, too, is not always confined to the *genus homo*. Rats, beetles, fleas, cats, and bull-dogs are among improbabilities which come within the scope of actual personal experience, the smaller species being the greatest nuisances. Poison for beetles may also be objectionable for human consumption, and an unsuccessful crusade of beetle extermination resulted in a six weeks' dangerous illness for the originator of the idea; fleas are equally hopeless in many riverside stations.

Facilities for the obtaining of circulating water are naturally of great weight in the selection of a site for a generating station, but the staff will never forgive the originators of the plans of a certain station which is immediately adjacent to the town's sewage farm. Regularly at 4 a.m. the engine room floor was sprinkled with carbolic powder in the endeavour to combat the effluvia resulting from cleaning operations next door—a precaution which was so far successful that it enabled one with a struggle to just support animation. This station also supplied steam through a reducing valve, giving 80 lb. per sq. in. from a 160-lb. supply, to the neighbouring air compressors and sewage pumps; the inauguration of this arrangement was the occasion of much trouble from this valve, which persisted in alternately sticking open and shut; the effect was exceedingly comic in the pump house, but also exasperating. It was several weeks before that valve consented to behave itself, in spite of all humourings and overhauls.

Seaside power stations have certain troubles to contend with which do not obtrude themselves upon inland localities. Particularly along the "front," salt water spray attacks all polished work relentlessly, and arc lighting is only possible by the aid of quantities of vaseline upon rods, &c. When this state of affairs is aggravated by bad arrangements of gear, and neglect on the part of the outside staff, things tend to become chaotic. Such were the conditions when and where the writer was apprenticed; and, as the junior station man, it was frequently his lot to assist also on outside work. A particular set of arc lamps illuminated a busy jetty, and had an unpleasant habit of refusing duty in the early winter mornings. Two a.m. once saw the writer lashed up to the top of a lattice pole endeavouring to locate the trouble in one of these lamps, in pitch darkness and heavy rain; and the language used when eventually it was discovered that the day duty arc trimmer had left one lead disconnected from its terminal almost obviated the necessity for any other illuminant. Then immediately afterwards, when operating the D.P. knife switch controlling this circuit, and with both feet in a pool of water, the handle of the switch came away, causing the operator to slip and so deposit his hand neatly across the live terminals. The arrangement of the control gear, apart from its questionable quality, was very poor, and most things were beautifully un-get-at-able. Live lamp poles were of frequent occurrence, and main circuit fuses were well down in the pole bases, quite a foot below the level of the door. Faults of all sorts were, of course, common, and arc shunt coils burnt out with regularity and frequency.

Scales of bus-bar voltmeters are usually "set up," that is to say, they do not indicate when the pressure is more than, perhaps, 10 per cent. below or above normal; and this is a practice which is most convenient and desirable.

But if the paralleling gear is not of the balance type, wherein equal bus and incoming pressures give a zero reading (and in the case of A.C.) it is also desirable to have at least one bus voltmeter with a full scale, together with similar instruments for machine pressures. A certain D.C. network is supplied by steam sets in parallel with a large, but somewhat remote rotary converter sub-station. A complete shut-down of the directly steam-generated supply threw the load of the local district on to the outlying feeders of the sub-station, so that the latter's pressure feeding back to the station was about 25 per cent. low; time was then wasted in connecting up temporary voltmeters for paralleling in again, for all the permanent instruments were set up and were showing no reading. Except for this proviso, large scale voltmeters, steam-pressure, and vacuum gauges are excellent aids to accurate and smooth operation and regulation, and in an A.C. station direct-reading KW.-meters on all machines and the more important feeders are equally desirable. Steam-flow meters on boilers, too, are beginning to be realised to be as useful and as necessary as ammeters upon D.C. generators.

Rotary converters and motor-generators are not often run together in parallel on both supply and delivery, but they operate very well under these conditions so long as neither the speed nor voltage variations of the supply are frequent or excessive. Their characteristics are, of course, rather unlike in these two particulars, and they tend to alter their load distribution rather much if one variable changes without a corresponding alteration in the other. Rotaries, as a class, require a good deal of tact in operation. A certain trio of very large converters (A.C. to D.C.) had a nasty habit of occasionally developing surging between them, and this usually ended in a flash-over unless in the incipient stages the fields were varied quickly and skilfully. To minimise the trouble the D.C. breakers were fitted with lightly set reverse relays, and it became the practice to synchronise the incoming rotary with its volts slightly low, in order to ensure that it picked up load on the D.C. side immediately. This was being done by routine on one occasion when the load was rather light on the running machine, and just as the A.C. switch was closed (and it was a trifle "late") a D.C. feeder tripped. There was a slight flash from the incoming rotary's commutator, the running one tripped on reverse (D.C.), and there was no sign on the D.C. or A.C. voltage charts of any irregularity! On another occasion one phase of a two-phase generator, supplying, amongst other demands, a large six-phase rotary converter, was accidentally opened; apart from a drop in volts, no great trouble occurred; all synchronous plant remained in step, and normal conditions were resumed without further comment when the second phase was reconnected.

Automatic boosters and regulators are frequently looked at askance by the older generation of engineers, but, on the whole, they operate well, albeit more than one "automatic" booster has been stripped and converted into a plain shunt hand-regulated machine after the patience of the station staff has been exhausted. Regulators are more satisfactory when they are designed together with the exciters upon whose fields they operate, and it sometimes pays to keep the exciter's voltage more or less constant at the regulator's best operating value, by means of hand adjustment of a rheostat in the main rotor circuit. Some old-type regulators are liable to hunt upon slight provocation, and one experimental model succeeded in giving a very good imitation of lightning effects upon the lights supplied; it was, of course, quickly cut out, and never afterwards had any opportunity given it to repeat the entertainment. It has often been stated that it is impossible to operate machines controlled by separate regulators with "astatic" characteristics, in parallel; but if the machines, or groups of machines, are situated in different stations, it is quite a satisfactory arrangement, provided always that the interconnecting lines have sufficient resistance or reactance to allow a margin of scope for the regulators, and the system is in actual daily operation.

Remote control switches are addicted to occasional vagaries in their operation, and should be systematically inspected and overhauled. In one instance an earth on some lighting supplied from the same source as the relay operating circuits caused a generator switch, having another earth on its control wiring, to trip and immediately close again; the fuse on the lighting sub-circuit then blew, and it was not until it had been renewed and the cycle repeated that the cause of the very heavy surge was realised, for the operation of the generator switch was not observed in the first instance. Similarly, a generator switch once developed a very long time-lag in closing, so that when the set was synchronised, the signal lamps lit up for "closed," but the switch was actually only slowly travelling into contact. The operator, noticing the behaviour of the synchronoscope, realised that something unusual had occurred, and immediately proceeded to draw the E.H.T. isolating links. He had drawn two by the time the switch actually arrived home, and thus had averted disaster, for the neutral was not in this case earthed. Indicating lamps should be on entirely separate circuits from the control system, and their contacts should preferably be mounted upon the rods carrying the main H.T. contacts; this is so arranged by some makers, but should be specified in all remote control contracts. Failure to operate altogether is generally due to lack of attention—*i.e.*, journals or clutches remaining dry and seizing, stiff toggle joints, and similar mechanical details; but faulty operation is even more dangerous, and is usually the result of mechanical wear, sparking at contacts, or electrical open or short circuits in the control gear; occasionally a current transformer will be found to have increased its ratio by a partial short-circuiting of the H.T. turns, but such cannot easily be detected until an actual breakdown occurs. Time-limit fuses should be religiously tested for continuity before use, and when unsatisfactory, put unmistakably on one side; considerable time and much energy were wasted in testing the parts and functions of a switch whose operation was inexplicable, until the whole trouble was eventually found in a faulty time-limit fuse which appeared to the eye to be perfect.

All switches, levers, and valves ought to be labelled, but such labelling can be carried too far; and if sketches are provided they should be diagrammatic rather than actual working drawings, and inscriptions should be bold and suitably placed. Modern switchboards tend to uniformity of appearance, panel by panel, and it is often a fatally easy matter to operate a wrong switch, particularly with remote control A.C. Standing alternators have been switched in instead of running rotaries, and similar mistakes made which might have been avoided by the use of conspicuous labels. A raw improver was once sent to shut down a roof fan, and, instead, proceeded to open the unlabelled main switch of the driving side of a motor-generator, which supplied the excitation to the largest A.C. unit in use at the time; naturally, the results were far from happy, but the whole episode might have been avoided by the use of a suitable label.

CABLE FAULT LOCALISATION IN PRACTICE.

By D. M. W. HUTCHISON, M.I.E.E., B.Sc.

There are not many methods of locating faults in underground mains which are of much use to the mains engineer, and really practical information on the subject is not easily obtainable. The writer hopes that by giving some of the actual results of his own experience in the past, he may be of some service to engineers in charge of cable work.

Several years ago the writer had charge of a cable system composed partly of three-core jute-insulated V.B. sheathed cables and partly of lead-covered paper-insulated three-core cables. Faults occurred on the system at the rate of about one a week; most of the faults occurred on the V.B. cables, which were eventually replaced by paper-insulated lead-covered cables.

A few weeks' work convinced the writer that one of two tests would serve to locate any fault that could be located with certainty; these were the loop test with a special bridge, and a fall of potential (F.P.) test.

Loop tests, with the dial resistance boxes supplied in so-called "mains testing sets," and search coil tests, were found to be very inaccurate, and were abandoned.

The bridge used consisted of 500 in. of No. 16 copper wire marked in 10-in. sections by rings of paint on the wire itself. This wire was stretched round insulators on a board; the ends were sweated to V.I.R. leads of equal length, provided with terminals suitable for attachment to link box, fuse box, or feeder pillar fittings, or to cable cores.

Current for testing was taken from the mains, and a resistance of 10 25-C.P. carbon lamps was used; the galvanometer used was that fitted in a mains testing set, but later on the millivoltmeter of a Century testing set was found to be more sensitive; a tapping key was used in the galvanometer circuit.

For the F.P. test, a 4-volt accumulator or a bank of lamps, a reversing switch, an arc-lamp resistance, and the same galvanometer as used in the loop test were all the apparatus required.

On the occurrence of a fault the procedure was as follows:—All service fuses were removed, both ends cleared, and a Megger test and lamp tests were made; the fault was then classified as follows:—

Class (1) All cores shorted and earthed.
(2) „ „ „ but not earthed.
(3) Two cores shorted, third good, no earth.
(4) „ „ „ and earthed, third good.
(5) One core earthed, others good.
(6) Total disconnection.

In Classes 3, 4, and 5 the loop test was used provided enough current could be passed through the fault to make the resistance lamps glow.

In Classes 1 and 2, and in Classes 3, 4, and 5 where the fault was of sufficiently high resistance to prevent the lamps glowing, the F.P. test was tried.

In Class 6 the method used was cut and try, attempts at localisation not being consistently successful.

It is important that the lamp tests should be made to supplement the Megger tests, as may be seen by studying the examples given below.

If a loop test was possible, the equivalent length was calculated in the usual manner, and one example will suffice to show the method used.

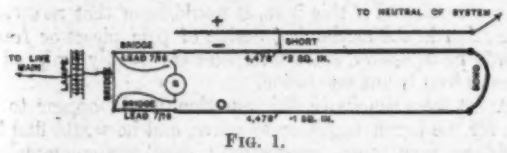


FIG. 1.

EXAMPLE I.—Fig. 1 (loop test, Class 3 fault), 3-core V.B. cable.—Megger tests.

+ to E	5,000 ω	+ to 0	12,500 ω
— to E	5,000 ω	— to 0	12,500 ω
0 to E	12,500 ω	+ to —	zero ω

A lamp test showed that it was possible to light the bank of lamps through the short circuit.

LENGTH OF LOOP.

Length of cable	...	4,478 ft.	·2 = 4,478 ft.
0 cable	...	4,478 ft.	·1 = 8,956 ft. ·2 sq. in.
„ „ bridge leads		24 ft.	1/6 = ·215 ft. ·2 sq. in.
Total	...	...	13,649 ft. ·2 sq. in.

1 in. on bridge = 13,649/500 = 27·29 ft. on ·2 cable.

The test was made according to the above diagram, the wire from the lamps being moved up and down the bridge wire until the millivoltmeter showed no deflection; the bridge leads were then reversed, and another reading was taken.

The calculation is a simple one, thus: zero position was found on the average of the two readings to be 154 in. from the end of the bridge attached to the faulty cable.

Distance to fault 27·29 × 154 = 4,202 ft. 6 in., less 107 ft. 6 in. for one bridge lead = 4,095 ft. of ·2 sq. in.

A check test from the other end gave a slightly different position; the mean was taken, and the fault was found 30 ft. away, an error of ·67 per cent.

With a loop test the error in most cases was well under 1 per cent.

EXAMPLE II.—Fig. 2 (loop test, Class 3 fault).—This has been given, as it is a good example of how the Megger tests may be misleading if not supplemented by lamp tests.

THREE-CORE V.B.—MEGGER TESTS.

+ to E	500,000 ohms	+ to —	zero ohms
— to E		+ to 0	
0 to E		— to 0	

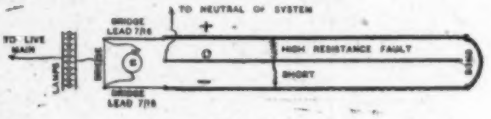


FIG. 2.

A lamp test, however, showed that it was possible to light the lamps through — to 0 only; they would not light through + to 0 or + to —. This could then be classed as a Class 3 fault, and a loop test applied.

The error in locating this particular fault was 16 ft. in a length of 451, or 3·5 per cent.; this large error was due to the negative core at the fault being almost entirely burnt away.

Faults of Classes 4 and 5, provided the lamps can be made to glow through the fault, are tested out in exactly the same manner as Class 3 faults.

In making loop tests the *sine qua non* is to have one sound (that is, comparatively sound) return; loop tests should be used in preference to F.P. tests where possible, as they are less liable to external disturbances.

In making loop tests it should be remembered that if the galvanometer cannot be made to reverse through zero by sliding the wire up the bridge from end to end, there is a disconnection in the loop, probably a core burnt away.

All connections in the loop should be clean and tight, and if it is necessary to use a bond at the end of the loop, this should be made short and heavy. If it is impossible to make good mechanical connections, sweating should be resorted to, but good mechanical joints can usually be made at feeder pillar and network boxes.

This brings us to the classes of fault where F.P. tests were necessary.

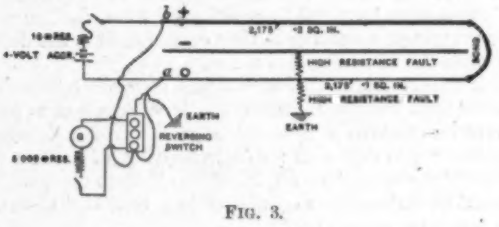


FIG. 3.

EXAMPLE III.—Fig. 3 (F.P. test, Method I), Class 4 fault.

MEGGER TEST.

+ to E 30,000	ohms	+ to — 35,000	ohms.
— to E 15,000		+ to 0 35,000	
0 to E zero		— to 0 zero	

A lamp test showed that the lamps would not glow through the fault, so that a loop test was not possible.

The reversing switch is an arrangement of three tumbler switches, whereby readings of the F.P. between *a* and fault and *b* and fault can be taken without reversing the galvanometer leads.

A 4-volt accumulator was switched on, and readings were taken quickly; an average of about six readings were always taken.

The method of calculating the distance to the fault is simple, thus:—

Length of loop, 6,525 ft., equivalent	...	...	·2 sq. in.
Deflection *a* to fault corrected for shunt	...	...	24
Deflection *b* „ „ „	...	...	40·5
Distance of fault from *a*, 24 × 6,525/64·5 =			2,425 ft.
Being on the neutral, this is	...	...	1,212·5 ft.

The error was 12 ft., or ·55 per cent. on length.
There were no earth deflections in this test.

D

EXAMPLE IV.—Fig. 4 (F.P. Test, Method II).

This is an example of the method which was used for faults of Classes 1 and 2.

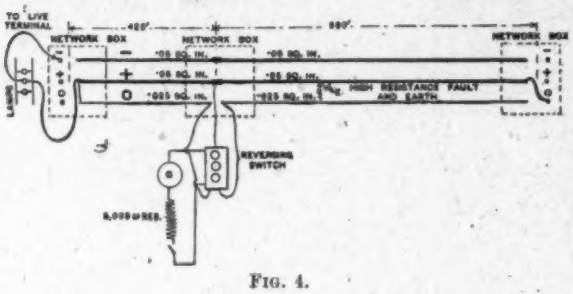


FIG. 4.

A length of sound cable is connected to the faulty length; this can sometimes be done through link or fuse boxes, or otherwise by cutting the faulty cable; readings of the potential drop when current is passed through as shown are taken, and the position of the fault is calculated.

MEGGER TEST.

+ to E zero	} ohms	+ to − 100,000	} ohms.
− to E 100,000		+ to 0 zero	
0 to E 1,000		− to 0 100,000	

No current could be passed through the fault for a loop test, so this was treated as a Class 1 fault.

Length of faulty cable	...	660 ft. ·05 sq. in.
Length of sound cable	...	420 ft. ·05 sq. in.
Deflection sound cable	... ...	26·5
Deflection faulty cable	... ...	19·0

Length to fault $420 \times 19/26{\cdot}5 = 301{\cdot}5$ ft.

It was found advisable to deduct an allowance of 3 per cent. from the calculated length when using this second method with V.B. cables when the faulty cable was earthed; this is probably due to the added resistance near the fault, due to the cores being badly burnt.

Length to fault, corrected = 292 ft.
Error 1 ft. 6 in. = ·16 per cent.

In F.P. tests there will sometimes be earth deflections, and these must be added to or deducted from the galvanometer readings, according as they oppose or help the deflection when the test current is on.

It is a good plan to put a resistance of about 5,000 ohms in series with the galvanometer in these tests, and to regulate the test current so as to get a good readable deflection when the key is depressed; this saves a lot of trouble due to earth deflections, but all the same, if these are variable, it is almost impossible to get a reliable test, and therefore it is better to cut and try.

It is important in F.P. tests to keep the test apparatus well insulated from earth, and to see that the galvanometer leads are attached to the ends of the cable under test—*i.e.*, the testing circuit should not include any unavoidable joints; the joint between sound and faulty cable in Method II should be a good one.

In Class 2, faults using F.P. test, Method II, the history of the fault has to be roughly taken into account; if a bad burn out is suspected, which rather depends upon the fusing of the network and class of cables, a deduction of 3 per cent. should also be made, as in Example IV.

No examples have been given of F.P. tests on Class 3 and Class 5 faults, but they are only variations of the tests given in Examples IV and III respectively.

Electric Steel in New Zealand.—The Industries Committee of the House of Representatives has presented a report on the utilisation of steel scrap and waste. The Committee has had under consideration a proposal from Mr. Thomas Waddell, of Christchurch, to establish a plant for the melting of scrap steel by an electrical process. The Committee recommends the remission of Customs duty on the machinery for the erection of the electric furnace, and is of the opinion that the production of iron and steel in the Dominion is a matter which should receive the attention of the Government.

IRON COMMUTATORS.

BY FREDERICK MURGATROYD, B.Sc. TECH.

THE fact that war conditions in Germany have necessitated a limitation of the use of copper and enforced the manufacture of iron commutators in certain classes of machines, raises the whole question of the commercial possibility of iron for this use after the war. Presuming that an iron commutator will always be cheaper than one made of copper, then, provided there are no insuperable commutation or mechanical difficulties in operation, we can safely assume that the iron commutator as a commercial proposition has come to stay.

Past experience of commutation problems, however, should deter us from making final decisions on this question from mere theoretical considerations. Commutation problems, electrical and mechanical, are so abstruse that only practical experience in the operation of iron commutators will supply the verdict as to their commercial future. And whilst British engineers will naturally watch developments in Germany, it would be wise for manufacturers here seriously to tackle the question of iron commutators on their own account.

The chief objection to this use of iron in place of copper is that a magnetic material replaces a non-magnetic. This means that we are adding to our already large list of commutation factors, a field produced in the iron segments due to circulating currents in the coils undergoing commutation. This field is radial, and coincides with the axes of the brushes. The effect is equivalent to increasing the reactance voltage, as this extra field has now to be neutralised before commutation can be completed. The result, therefore, is that with an iron commutator, either the lead of the brushes or the interpole strength must be increased. This portion of the subject has already been investigated in Germany, and it was found that in the case of a 100-KW. dynamo designed for 110 volts at 580 R.P.M., the short-circuit voltage in one coil was increased by 35 per cent. on replacing a copper commutator with an iron one.* The increase required in the interpole flux is stated as 10 to 15 per cent., and if this is so, it would seem that no serious alteration in the mechanical design of pole pieces or frame should be necessary, since interpoles are usually designed to operate well below saturation.

Apart from the above, the question would appear to be one for the brush engineer to solve, and he would find his problems very much aggravated. Sparkless commutation would be attained with much greater difficulty in view of the increased reactance voltage and the extra attention required to maintain a good polished commutator surface. Not only would great care be needed in the choice of the brush quality, but careful nursing would be a *sine qua non*. In the latter connection, the first consideration would be that of the mica. It is, perhaps, safe to say that the majority of the brush troubles which are not electrical in origin, are traceable to obstinate mica. Mica protrudes for two reasons; either it works up due to the alternate heating and cooling operations it undergoes, or else the brush is insufficiently abrasive to wear it away at the same rate as it wears the copper segments. We so often speak of "hard" or "soft" mica, that we are apt to forget that "hardness" is no criterion of this "rate of wear." For ideal conditions the mica's resistance to abrasion should never exceed that of the metal segments, and, as already stated, the resistance to abrasion of any material bears no exact relation to its hardness as determined by any of the usual methods. Now, from experience gained in comparing the rates of wear of iron and copper or gun-metal rings with the same quality of brush on each, we can safely assume that an iron commutator would wear less than a copper one under the same conditions. It seems, therefore, that a more obstinate grade of mica would be possible, and this is a distinct advantage. With recessed mica the commutator might approximate somewhat to steel rings, with which some experience has already been gained. It is well known that certain grades of highly-graphitic brushes operate

* Vide *Elektrot. u. Maschinenbau*, 35, pp. 273-276, June 10th, 1917.

excellently on steel rings, giving a good polish to both ring and brush contact surface, and producing little ring or brush wear. It is quite possible, therefore, that highly-graphitic brushes would run well on slotted iron commutators, and the fact that such brushes are usually a good commutating type encourages this point of view.

With regard to the difference in friction coefficient and contact drops as a result of the change from copper to iron, it may be noted that German experience seems to show that there is practically no difference in the temperature rise of iron and copper commutators working under identical conditions. Whether this should be taken as fact, or whether German engineers are merely making a virtue of necessity, is certainly doubtful.

That iron commutators would require careful watching in operation is obvious, and, in certain situations, such as in hygroscopic atmosphere, the formation of rust may forbid the adoption of iron. Rust trouble, however, might be satisfactorily overcome by staggering the brushes, so that the brush paths cover the whole length of the commutator. Tendency to rust is, of course, the main objection to steel rings, for it has been found that a slight oxidisation generally occurs when the machine is allowed to stand, though, as mentioned previously, this is usually insufficient permanently to injure the good contact surface of the brush or ring. In the case of a commutator the oxidisation may usually be equally unimportant, and the use of an impregnated brush, by distributing a thin film of oil as a protective coating over the surface of the commutator, may be an effectual remedy in cases where the tendency to rust is excessive.

Trouble may occur with recessed mica owing to an accumulation of rust, or an oil and rust paste, in the slots of the segments, but this is not a detail which should present any difficulty in overcoming it, and in cases where the machine is rarely examined, the remedy would probably be to run on flush mica, using a suitable hard carbon brush.

As stated above, the commercial value of the iron commutator can only be finally settled after actual experience in its use; but judging merely from a theoretical standpoint, the iron commutator would seem to have a certain, though probably a very limited, future.

CORRESPONDENCE.

Letters received by us after 5 P.M. ON TUESDAY *cannot appear until the following week. Correspondents should forward their communications at the earliest possible moment. No letter can be published unless we have the writer's name and address in our possession.*

Meters on a Changed Frequency.

The question raised by "Query" in your current issue can only be correctly answered after one has heard what particular type of meter is in circuit.

A short time ago one of our largest meter manufacturers decided to test one meter of each type then on the market, and comparisons of all kinds were made, amongst them being that of variation with changes of frequency. Needless to say, vast differences were recorded as between types, and the errors were found to be increased on inductive loads.

The figures for two British and two Continental meters (all four in general use in this country) were as follows:—

BRITISH METERS.

		Half load P.F. 1·0.	Half load P.F. 0·5.
(*a*)	40 period,	1 per cent. slow.	4·0 per cent. slow.
	50 "	O.K.	0·6 per cent. "
(*b*)	40 "	1 per cent. slow.	3·5 per cent. "
	50 "	O.K.	O.K.

CONTINENTAL METERS.

(*c*)	40 period,	3 per cent. slow.	4 per cent. slow.
	50 "	O.K.	O.K.
(*d*)	40 "	2·4 per cent. slow.	6·0 per cent. slow.
	50 "	0·4 per cent. fast.	2·6 per cent. fast.

Unless, therefore, the majority of meters in question are of Continental origin, or the circuits are mostly for power purposes, there is no need for "Query" to worry about the change of frequency. Certainly no method of voltage variation will compensate, because A.C. meters are all watt-hour meters, and, therefore, as regards accuracy are independent of voltage variation.

T

Urmston.

Illuminating Engineering.

The criticism of your correspondent on my address to the Illuminating Engineering Society is welcome, and for any discussion on it I should be grateful.

Mr. Cook suggests that I encourage the idea that an engineer "has done his duty to himself in accepting the sense of sight as judgment from one whose mind he has omitted to tutor in its requirements." I thought that I had already wandered too far into psychology and other philosophical matters, and I hesitate to enter into the extremely interesting question of the intellectual relations which do, might, or should exist between a professional man and his client. Business is started by a statement by the client of what he thinks he wants. Sometimes he knows this so exactly that the engineer has only to see that he gets it. At other times, the engineer must amplify the details by investigation into the case, and forms his own opinion, based on technical experience, on what he judges that his client really wants. It is rather a delicate matter to act as a tutor, or to do more than "elucidate" qualities to him. If he "preaches" "subordinate diversity factor" and "the loss of intrinsic brilliancy as reduction in illumination," to quote Mr. Cook's words, he may weary, or even annoy, his client, unless a good deal of tact be used. May I quote another part of my address? "Even if an instrument should one day be invented, as Lambert hoped, which would indicate a quantity of light on a scale like a thermometer, our client's opinion of the lighting will not be materially influenced. Illuminating engineers must, therefore, give some attention to the subjective, and to physiological interpretations of sense-impressions." The boot-maker cannot tell where the shoe pinches, but a knowledge of the anatomy of the foot will help him to give relief. The oculist may preach to any extent, but the patient will generally insist on having glasses which help him to see better. And so with all the senses.

"The more liberal education from engineers, direct to the public," to which Mr. Cook alludes, is one of the main objects of the Illuminating Engineering Society, and its enthusiastic honorary secretary is great on propaganda. But a good deal may first be done among engineers themselves if they can be induced to study the subject. Like other branches of optics, it offers pegs on which mathematicians are tempted to hang festoons of formulæ, pretty problems, and elegant equations, and neologists to adorn with lumens, lamberts, and milli-phots. But the more practically minded engineer applies simple measurements to actual cases, much as we used to design dynamos a third of a century ago, and build up experience thereon.

In this connection I should like to comment on Lieut. Stroud's criticism on page 586 of the review on "Modern Arc Lamps and Incandescent Lamps." He rightly suggests that in the absence of any information about the kind of opal glass, exact comparisons of semi-indirect, and of direct lighting are not possible. But in his final paragraph he says that "the proper comparison should have been made with the most efficient type of open reflector," when it will be found that "semi-indirect lighting is 40 per cent . . . dearer than direct lighting." The introduction of the reflector complicates the comparison. The first question is to find the loss of light, if any, due to the use of an opal bowl or hemisphere.

I use such bowls in my house, and there is one in one of the rooms at the offices of my firm. I have made measurements of the illumination received on the tables below these lights. At home I use Ediswan "Downlite" lamps in sand-blasted opal bowls, procured also from the Edison & Swan Co. The ceiling has not been whitened for nearly four years.

With the bowl, the illumination on the table from one light only was 0·62 ft.-candle. On removing the bowl it was 0·65 ft.-candle. The direct illumination was, therefore, 5 per cent. greater than the indirect. With the bowl in place, the brightness of the ceiling nearly over the lamp was equivalent to that of a white screen receiving an illumination of 3·6 ft.-candles. With the bowl removed it was 1·6 ft.-candles. At my offices the difference on the table was less, and was barely measureable. The brightness of the ceiling, which was whitened about four months ago, was 2·8 with and 1·6 without the bowl.

The light reflected from the bowl to the ceiling, and again reflected downwards, depends on the reflecting power of the opal glass and on the solid angle subtended by it. The light received directly from the under surface of the bowl depends on the intrinsic brightness of the glass. In my house the lamps are deep down in the bowls. Raising a lamp 2 in. causes an increase of the portion of the ceiling illuminated, but reduces the brightness of the glass so much that the illumination on the table is reduced from 0·65 to 0·49. I was unaware of the importance of the position of the lamp in the bowl until I made this simple experiment.

A. P. Trotter.

Westminster, *January 11th.*

Distinctive Colours for Braided Cables.

It gives me very great pleasure to again acknowledge the receipt of the good old REVIEW for the period since my last letter. It has turned up with clockwork regularity except when we have been on the move, when it follows up a day or so later than usual. It is appreciated as much as ever by all the electrical men of this section. With reference to the letter on distinctive braidings for V.I.R. cables, by your correspondent Mr. T. D. Spark, I should like to add my appreciation of his suggestion. Since I have been in France I have used a quantity of yellow braided cable. Perhaps it would be more correct to say yellowish-brown. This is the colour your correspondent suggests, but I rather fancy this wir-

was of French manufacture. French electricians use a lot of this cable for electrical installations, so it is quite possible that British firms manufacture cable of the same colour for the French market. Wishing you the compliments of the season.

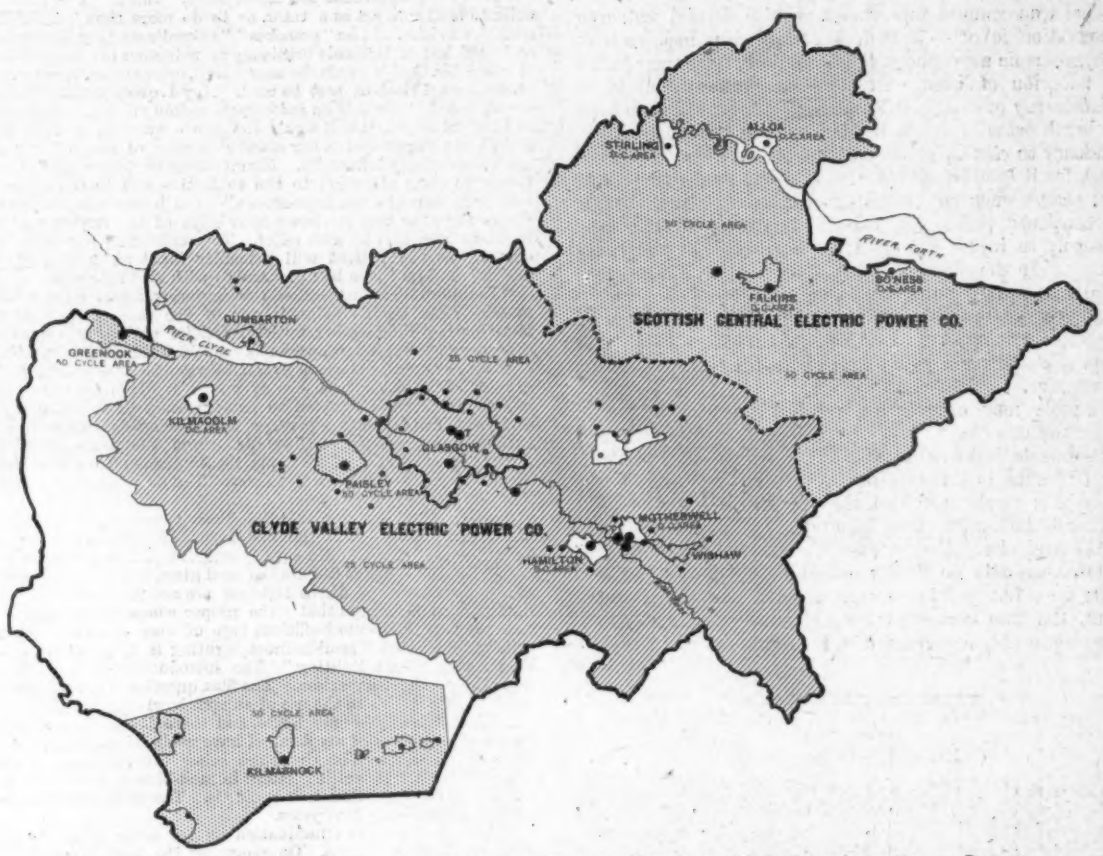
Harry Payn,
London Electrical Engineers.

B.E.F., France, *January 5th*, 1917.

WEST OF SCOTLAND LINKING-UP.

In our last issue (p. 46) we published a fairly full abstract of the report of the West of Scotland Committee for the interconnection of electricity supply undertakings.

Through the courtesy of Mr. F. H. Whysall, chief electrical engineer, Greenock, and hon. secretary of the Committee, we are now able to reproduce a map of the area referred to and a summation load curve showing the combined week-end loads of the undertakings concerned for which provision would be made by interconnection. We also append a table giving particulars of the undertakings in the area covered by the map. Readers are referred to our last issue for details of the report, which briefly divides the undertakings into four groups—A, B, C, and D—and further into joint groups of A and B, and B and D, these being denominated E and F respectively. Group A comprises the Paisley, Greenock, and Kilmarnock undertakings; Group B, the Glasgow and Clyde Valley Power Co.'s undertakings; Group C, Alloa, Bo'ness, Falkirk, and Scottish Central Power Co.'s undertakings; Group D embraces all direct-current undertakings, and no linking-up is proposed; Group E includes the Clyde Valley Power Co. and Paisley; and



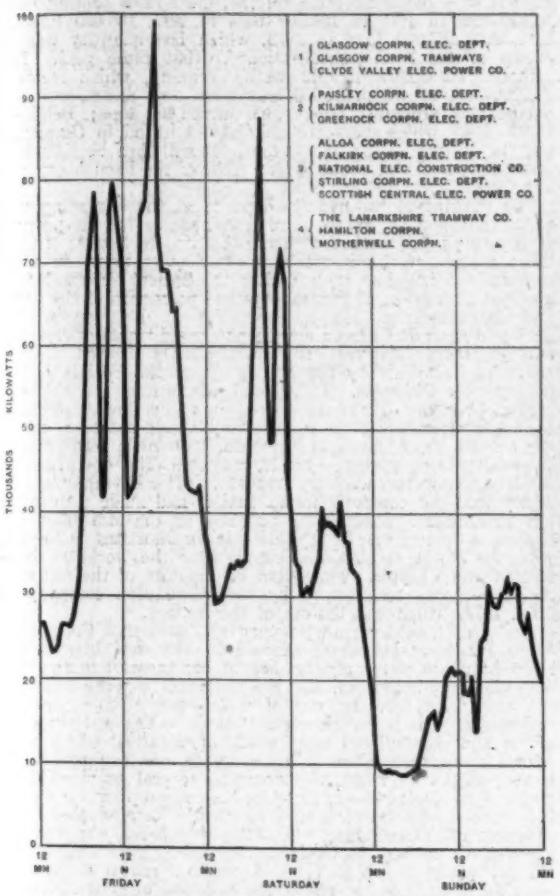
MAP OF WEST OF SCOTLAND AREA; BOUNDARY SUGGESTED BY NATIONAL E.P.S. COMMITTEE SHOWN DOTTED.

PARTICULARS OF WEST OF SCOTLAND ELECTRICITY UNDERTAKINGS.

Undertaking.	System.	Voltage.	Max. load, kw. Winter, 1916-17.	Generators, kw.	Boilers, kw.	Spare boilers at peak load, kw.	Remarks.
Alloa	D.C.	440	668	1,201	Gas plant	—	—
Bo'ness	D.C.	460	700	1,000	800	100	Leased to Nat. Elec. Const. Co.
Clyde Valley Power Co. (Motherwell, Yoker, and Clydesmill)	3-p. 25 c.	11,000	25,000	40,000	33,000	8,000	Bulk supplies to Wishaw, Coatbridge, Airdrie, Dumbarton; other towns and villages are supplied; 20,000-kw. extension in progress.
Falkirk	3-p. 50 c.	6,600	950	1,500	950	—	—
Glasgow	3-p. 25 c.	20,000	45,000	55,000	55,000	10,000	Extensions of 30,000 kw. are in progress; systems are linked-up.
Glasgow (tramways)	3-p. 25 c.	6,500 6,600	18,000	22,500	18,000	—	
Greenock	3-p. 50 c.	10,500 3,300	7,800	14,000	12,000	3,500	Includes supply to Port Glasgow.
Hamilton	D.C.	480	1,180	1,180	1,500	700	—
Kilmarnock	3-p. 50 c.	11,300 3,300	3,500	5,000	5,000	1,500	Supply to towns and villages in district.
Kilmacolm	D.C.	480	75	175	200	—	—
Lanarkshire C.C. (Cambuslang)	D.C.	500	—	—	—	—	—
Lanarkshire Tramways Co. ...	D.C.	520	790	825	1,200	—	850 kw. purchased from Clyde V.P. Co. (not included in maximum demand).
Paisley	2-p. 50 c.	2,000	2,500	6,400	3,500	1,000	—
Motherwell	D.C.	500	1,900	2,940	3,200	—	—
Scottish Central Power Co. (Bonnybridge)	3-p. 50 c.	6,600	3,000	6,000	3,500	500	Bulk supply to Denny; other towns and villages supplied.
Stirling	D.C.	460	360	620	—	—	—

Group F the same company and the Lanarkshire towns in Group D.

The cost of providing links of maximum utility under existing conditions is estimated at £134,870, and the annual saving is put at £19,140, or omitting Group B, the outlay would be £118,870 and the estimated saving £9,140 per annum.



COMPOSITE WEEK-END LOAD CURVE OF UNDERTAKINGS MENTIONED.

The Committee consists of Mr. George Balfour (chairman), Mr. F. H. Whysall (vice-chairman and hon. sec.), Messrs. R. A. Brown, G. F. Moller, G. Salter, J. Wishart, C. F. Parkinson, F. Coutts, Roland Marshall, C. T. Astbury, J. Dalrymple, J. White, Thos. Ross, D. A. Starr, H. E. Ferguson, H. C. Babb, J. W. Napier, J. W. Papworth, W. C. Benson, E. T. Goslin, W. W. Lackie, A. Page, F. J. Launchbury, and H. Dixon.

NEW ELECTRICAL DEVICES, FITTINGS, AND PLANT.

Readers are invited to submit particulars of new or improved devices and apparatus, which will be published if considered of sufficient interest.

Three-Phase Live-Roll Motors.

The standard motor designed for ordinary electric driving purposes is totally unsuitable for operating live-roll gear and other auxiliary machinery in a steel works. The motor must have exceptional mechanical strength to withstand the frequent shocks experienced in consequence of the heavy loads suddenly thrown on the motor, the continual rapid reversing, and through the vibration of the gearing. Such a motor must, moreover, be totally enclosed to exclude metallic and other dust which abounds in steel works, and must at the same time have but small rotational inertia, in view of the fact that it may be called upon to stop and start as many as 500 times an hour in the course of its normal duty. In addition, the motor must be capable of rapid dismantling for inspection, overhauling, or repairs, enabling any adjustment to be carried out in such a way that stoppage of the plant is reduced to a minimum.

In three-phase installations a special form of induction motor is required to meet the conditions outlined, and the GENERAL ELECTRIC CO., LTD., have undertaken the manufacture of this class of machine; fig. 1 shows some of these machines, which are the first special live-roll induction motors to be manufactured in this country, and form part of a large contract for an important new works in the North of England.

The method of taking the motor adrift is explained in fig. 2, which at the same time displays the special constructional features. The external carcase is in two halves, and is of strong and heavy construction. With the removal of the bearing caps and bolts holding together the two portions of the carcase, the upper portion can be lifted clear, carrying with it the brushgear and the rotor leads. With this done, eyebolts are exposed which are permanently secured to the bearing bushes in which the rotor shaft runs, the bushes being bolted together inside the shell. By attaching the crane slings to these two eyebolts, the bushes can be lifted out, carrying with them the rotor and the stator.

The stator is composed of a separate ring of laminations built up in a containing frame and self-contained with the windings. After being lifted out of the bottom half of the carcase the rotor can be lowered to the ground and slid out of the stator. This

FIG. 1.—"WITTON" ROLLING-MILL INDUCTION MOTORS.

arrangement makes it possible, in the case of an accident to either rotor or stator, to take the machine adrift and insert either a spare rotor or stator complete in less than half an hour, without loosening the holding-down bolts.

The conductors are of the bar type both in rotor and stator, and are insulated with moulded mica. They are thus capable of withstanding high temperatures without deterioration, the insulation being at the same time non-hygroscopic.

In these machines mechanical considerations have first claim; the air-gap has therefore been made exceptionally large, being 0·1 in. (radially) in the 75-H.P. motor. Otherwise every care has been taken to give a high power-factor, and the machine is so designed that the power-factor increases on overload, at which time a good power-factor is of the most importance.

The motors are capable of withstanding a very heavy overload. They have a starting torque of 2·5 times normal and a high stalling point. Very substantial bearing bushes are provided

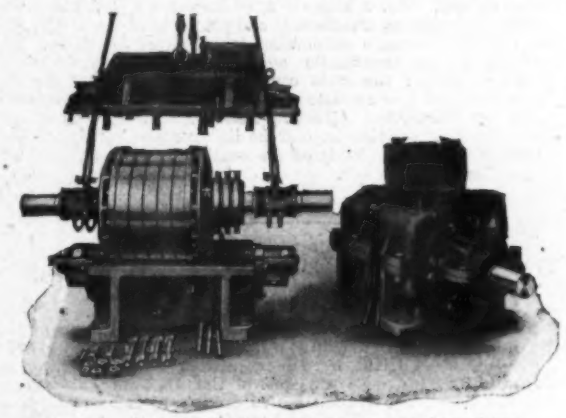


FIG. 2.—"WITTON" 75-H.P. THREE-PHASE LIVE-ROLL MOTOR ADRIFT.

lined with white metal, and very liberally designed. The journals in a 75-H.P. motor are never less than 5 in. in diameter and 12½ in. long. The slip-rings are of phosphor-bronze, of very large diameter, the brushes being arranged to carry the current continuously without short-circuiting.

In order to permit of rapid acceleration, retardation, and reversing, the rotor has been constructed of small diameter, and has therefore a small moment of inertia. To avoid breakage of the connections, the rotor is mounted on a spider which also carries the slip-rings.

The motor is symmetrically constructed, and the shaft is extended equally at each end. Not only can the drive be taken from either end of the machine when first installed, but if by any chance the shaft at one end of the machine becomes damaged, the motor can be turned round on its foundation bolts and can then drive from the other end, the centres being exactly the same. The extension end can also be used, if necessary, for a solenoid brake.

This class of machine is being satisfactorily used in steel works, not only for driving live rolls, but also for cranes and other auxiliary machinery.

Automatic Circuit-Breakers.

THE BRITISH THOMSON-HOUSTON CO., LTD., of Rugby, have issued particulars of a line of automatic circuit-breakers for A.C. and D.C., for use in heavy service up to 6,000 amperes at 650 volts. In addition to their usual standard designs, the makers have provided a free-handle tripping device and novel features in minor details, including a number of attachments to give automatic operation on overload, low voltage, reverse, shunt trip, and combined overload and reverse, as well as a time-lag on overload combinations. Auxiliary switches can be fitted for opening or closing an auxiliary circuit when the breaker operates, and any of the foregoing attachments can be added to circuit-breakers supplied without them, no alterations being necessary.

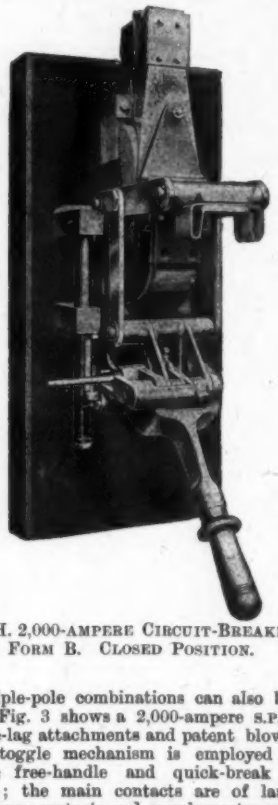


FIG. 3.—B.T.H. 2,000-AMPERE CIRCUIT-BREAKER, TYPE V, FORM B. CLOSED POSITION.

Double and triple-pole combinations can also be arranged for higher ratings. Fig. 3 shows a 2,000-ampere S.P. breaker, with overload and time-lag attachments and patent blow-out shield. A powerful double-toggle mechanism is employed for closing the breakers, of the free-handle and quick-break type, without auxiliary springs; the main contacts are of laminated copper, with auxiliary copper contacts and supplementary carbon contacts, which are renewable. All arcing takes place at the top of the circuit-breaker. The time-lag is of the dash-pot type, adjustable over a wide range, independently of the overload rating, and gives an inverse time characteristic.

THE FRENCH BAUXITE AND ALUMINIUM INDUSTRY.

ACCORDING to articles which were published recently by the Paris *Information*, the French production of bauxite prior to the war represented 60 per cent. of the total output throughout the world, the United States occupying the second position in this respect. The red bauxites mined in the South of France contain from 57 to 60 per cent. of alumina, and only from 2 to 4 per cent. of silica, and are therefore highly valued by makers of aluminium. In 1913, which was the last year of normal working, the production of bauxite amounted to 309,294 tons, as compared with 196,056 tons in 1910. Out of the total, 258,074 tons were raised in the region of the Var, 43,800 tons in the Hérault, 4,270 tons in the Bouches-du-Rhône, and 3,150 tons in the Ariège.

A portion of the tonnage of red bauxite extracted was consumed in France by the aluminium works spread over the Valley of the Arc, after the ore had been treated in works installed in proximity to the deposits at Gardanne (Société Electro-Métallurgique Française), Salindres and Beaucaire (Société d'Alais et Camargue), the Barasse, near Marseilles (Société d'Electro-Chemie), and Saint Louis, near Marseilles (Aluminium Français). These alumina works absorbed 100,900 tons of bauxite in 1911, 121,000 tons in 1912, and 143,000 tons in 1913, whereas the consumption in 1909 only amounted to 40,000 tons. Although the tonnage worked up in the country increased by over threefold in five years, the exports were of considerable volume, the figures passing from 14,000 tons in 1910 to 151,000 tons in 1911, 138,000 tons in 1912, and 168,000 tons in 1913, which last quantity was in excess of the home consumption in that same year. The principal customers in 1913 were Germany, which received 82,500 tons, of which 31,000 tons were sent direct, and the balance *viâ* Holland; Great Britain, 52,600 tons; Belgium, 10,900 tons, which were probably also sent on to Germany; and the United States, 12,000 tons. It will thus be seen that Germany purchased about 55 per cent. of the French exports, and Great Britain 30 per cent.

The working of the bauxite deposits at the beginning was embarked upon by purely mining companies for the purpose of supplying the market with ore, but in the course of time the producers of aluminium began to acquire mines in order to reduce their prime costs. Thus the Société Electro-Métallurgique Française, of Froges, obtained possession of the Caire and Beaume-Saint Michel properties at Mazaugues, the Société d'Alais et de la Camargue purchased rights at Loupian and Engardin (Tourves), and subsequently secured the deposits at Bedarieux by the absorption of the Société Métallurgique des Pyrénées. The British Aluminium Co. obtained control over the Union des Bauxites, whilst the Aluminium Industrie Gesellschaft, of Neuhausen, formed a branch under the title of the Aluminium Français, and made purchases at Thoronet, Vins, Camps, and Mazaugues. The operations of the latter, however, were unfortunate. After having extracted 40,000 tons the company found that it had made a mistake, but subsequently effected the purchase on the Marseilles Exchange of the majority of the shares in the Bauxites de France, with the object of obtaining supplies for the works at Neuhausen and Chippis. The board of directors of the Bauxites de France was reorganised by the Neuhausen company in July, 1914, which was the eve of the conflict.

Our French contemporary proceeds to state that the mining of bauxite has been more affected by the war than all the other branches of mining, as, despite the increase in the consumption of aluminium, the production of bauxite has considerably decreased. By way of explanation of this apparent inconsistency, it is mentioned that prior to the war the companies had accumulated large stocks of bauxites, which were drawn upon when labour became scarce, one company alone having stocks on hand amounting to several hundred thousands of tons. Moreover, the domestic consumption of bauxite has decreased, as various aluminium works have adopted other branches of manufacture. On the other hand, the war has arrested all exports to Germany, Holland, Switzerland, and Russia, whilst the high level of freights rendered business with the United States out of the question until the issue of an export veto on ores.

It is considered that although the war has dealt a heavy blow to the bauxite industry, the latter has a promising future in the era of peace, even if the more extended use of aluminium were merely limited to aviation and automobilism. But the future would be for ever compromised if the pre-war policy of continuing to supply Germany directly or otherwise were continued, and if measures were not taken, the newspaper concludes, to limit exports to countries associated with France in the defence of liberty and civilisation.

WAR ITEMS.

Trading with the Enemy.—The "London Gazette" for January 11th contains a very lengthy list of persons and bodies in Mexico with whom trading is prohibited.

Lighting Conditions in Petrograd.—The "Times" correspondent at Petrograd gives the following account of the gloom that prevailed on January 11th and 12th in that city:—"I am writing this message by the light of one candle, which the waiter warned me would cost two roubles 50 (5s. normal exchange). The gloom of the hotel corridors is intensified by lamps the size of nightlights placed at awkward turns and corners. Outside it is 20 degrees below zero, and inside one feels that the temperature is about the same. At 10 o'clock last night the electric light was turned off, and since then, excepting for five hours' daylight, we have been kept in darkness. Many parts of the city are in the same condition owing to the approaching exhaustion of fuel."

Control of Imports and Exports.—A meeting of merchants at Birmingham passed a resolution urging that, whilst it acquiesced in the control of imports and exports as a war measure, such control should cease except with enemy countries and subjects at the earliest possible moment consistent with national interests. That seems to us to be the same attitude as Sir Albert Stanley took up when resisting opposition to the Control of Imports and Exports Bill.

Exemption Applications.—The case of an electrical engineer at a war hospital came up before the West Riding Appeals Tribunal, at Leeds, against the decision of the Harro-

gate Tribunal. Applicant was married and B 1, and would have to report for service on February 15th. It was stated that the Furness Hospital (the place of employment) was being used for wounded soldiers, and 15,000 electrical treatments had been given there. The appeal was, however, dismissed, but the man is not to be taken away until a substitute had been found.

At the Shoreditch Tribunal, on Friday, the Mayor, Coun. H. Busby Bird, J.P., in the chair, Messrs. Osmond & Matthews, Ltd., of 13-29, Hearn Street, E.C., wholesale importers and factors of electrical goods, appealed for seven ledger and invoice clerks, a packer, a cashier and salesman, a carman, two stock-keepers, and a commercial traveller, the last of these also having a personal appeal. Mr. Wakeling said that on the ground that they had sucked the firm as dry as possible, he moved that the men be granted four months each. Another member pointed out that there were two clerks, aged 36 and 40, who were both B 1, but Mr. Wakeling said it did not matter; they had been through the lists so often that the orange was sucked dry. Finally it was decided to grant four months all round, with the previous V.T.C. conditions.

At Runcorn, on January 7th, two apprentices, aged 18, were appealed for by the Electric Light & Power Co. The Military Representative opposed, on the ground that the youths were neither skilled nor indispensable. A representative of the company said that after two years' service at the trade the youths could not be called unskilled. The Military Representative replied that they might be useful to the company, but they ought to be in the Army. The Chairman: But they are also of use to the Council and public of Runcorn. The company's representative said that they had lost nine men, and had 11 left. The area of supply included Runcorn, Widnes, Frodsham, and Helsby. Conditional exemption was granted in each case, with the Volunteer condition.

At Windsor, on January 3rd, Mrs. Fowler, wife of Mr. H. Fowler, electrician, renewed an appeal for the retention of F. J. Isgrove (18), apprentice in the business, Mr. Fowler being in the R.F.C. Mrs. Fowler stated that she had been unable to find anyone to take the youth's place. The firm was the only one of its kind in Windsor, and Isgrove and a lad of 16 were the only two left to do the work. When her husband joined the R.F.C. the conditions were that they should keep the foreman, but he had also gone. The Tribunal granted a month's respite for arrangements to be made with the Civil Liabilities Commission.

At Kendal, the Corporation electricity department opposed an appeal by the Military against absolute exemption held by an electrical engineer (41), on the ground that he was engaged in a public utility service. The certificate was amended to exemption until May 15th.

At Maidstone, three months' exemption was granted to H. Upton (30) and H. G. Tomlin (33), both passed for general service, coal unloaders at the Municipal electricity works.

The Sheffield Tribunal has granted exemption until June 30th to H. E. Maxey (38, Grade 3), electrician at the King Edward VII Hospital.

At Oxford, the National Service Representative applied for the withdrawal of exemption held by D. Campbell (38, B 1), traffic superintendent; T. Smalley (32, B 1), inspector and driver; and V. Hill (36, B 1), inspector and driver; employed by the Electric Tramway Co. The company applied for extended exemption for A. W. Oakley (37, Grade 3), unit adjuster and smith. Captain Sheild agreed to three months' temporary exemption for Oakley and Campbell, and in the cases of Hill and Smalley he contended that it was no longer necessary in the national interest for the men to remain in their present occupations. Inspectors' work could easily be done, as it was in London, by women. It was pointed out that the two men were not only inspectors, but experienced drivers and mechanics, and were now more important to the company then ever they were before. They had six inspectors before the war; now they had these two, and two female ones. They were reduced to the lowest possible margin. Oakley and Campbell were each exempted for three months, and Hill and Smalley for two months.

Before the Northants Appeal Court, the National Service Representative opposed exemption granted by the Northampton Tribunal to F. L. Perrin (26, Class A), electrical engineer, who has two businesses, and has a number of contracts in hand, on the ground that he had working for him five men and a boy. A final three months was granted.

LEGAL.

Action Against Tynemouth Electric Traction Co., Ltd.

At North Shields County Court on 11th inst., W. H. Brown, master boiler-cleaner, and J. A. Southern, miner, brought an action against the Tynemouth Electric Traction Co., Ltd., to recover damages for personal injuries received in a tramcar accident at Whitley Bay, on July 22nd last. Brown claimed £24 and Southern £15, and the company admitting liability, had paid into court £5 in Brown's case, and £3 in the case of Southern.

Brown stated that while travelling from North Shields to Whitley Bay on the top of a car, the trolley slipped from the wire. Southern and he were sitting together, and the trolley struck both of them on the head. He was ill for some days, and could not sleep at night. He did not consult a doctor until August 21st, when he saw Dr. Mort, of Middlesbrough, who gave him some medicine.

The Doctor, in reply to the Judge, said he gave Brown a "stomach" bottle.

The Judge said he thought the company had behaved very liberally in paying into Court the amount they had done. He gave judgment for the defendants. In the case of Southern it was stated by his solicitor that the amount paid into Court would be accepted. Judgment was entered for the defendants in each case with costs.

Electrical Engineer Fined.

At Warrington Police Court last week, Henry Tinsley, electrical engineer, of South Norwood, London, stated to be engaged on important work for the Government, was charged with having made a statement likely to cause disaffection, or to interfere with the success of H.M. Forces.

Mr. Thomas A. Moss, living at the Lion Hotel, stated that on November 9th, while having supper there, he heard the defendant ask the landlady as to troops leaving the district. The defendant, who was staying at the hotel, was heard to tell the landlady that the war would soon be over, and we should have to make the best terms we could. He also made other statements to the witness. The defendant denied having said anything about Germany having won the war. What he said was that we had a hard engineering problem in front of us, and we had to put our backs into it before we could get through.

Mr. Dodd, defending, said that if everybody was to have his conversation picked up and brought into a police court we should not know where we were. A fine of £25 was imposed.

Electrical Firm Fined.

At Manchester City Police Court last week, Messrs. A. W. Taylor and Co., electrical engineers, New Brown Street, were fined £3 for failing to exhibit a list of employés as required by the Defence of the Realm Act.

BUSINESS NOTES.

Plant for Sale.—Battersea Borough Council Electricity Department is inviting tenders for several steam dynamo sets in good condition. For particulars see our advertising pages to-day.

Fire Prevention.—Messrs. Associated Fire Alarms, Ltd., of Jewin House, Redcross Street, E.C. 1, have sent us particulars of a number of cases in which their automatic apparatus has recently prevented serious damage from being incurred through outbreaks of fire. In one instance, owing to the bearings of a hoist heating, the dust and fluff over the hoist became ignited, and within two minutes the Fire Brigade was on the spot. In several other cases the Fire Brigade was directly summoned by the apparatus in time to prevent the spread of incipient fires, and one alarm was given in the course of an air raid, saving an important building from destruction.

Manufacturers' Meeting.—The annual meeting of the National Union of Manufacturers (Inc.) is to held on Wednesday, February 6th, at 12 o'clock, at the offices, 6, Holborn Viaduct, E.C. 1. The secretary's report which will be submitted for adoption, shows that the Midland Branch, with offices at Birmingham, is making rapid progress. Local manufacturers are being canvassed, and many new members obtained. Trade sections of the Association are being formed. The present membership represents between £500,000,000 and £600,000,000 capital and from 350,000 to 400,000 workpeople. A questionnaire issued by the Association shows that a State Bank to help to assist the smaller manufacturers is an absolute necessity.

Cable Works Extension.—The *Gloucester Journal* states that the works so successfully carried on for some years past, adjacent to the banks of the river Wye, at Lydbrook Junction, by Messrs. H. A. Smith & Co., Ltd., electrical wire and cable manufacturers, have been recently enlarged, and special provision has been made for the comfort and convenience of the 250 employés. There is a spacious dining hall, cloak and bath rooms, lavatories, &c. A social gathering was held at the works recently, when the workpeople's appreciation found expression in the presentation to Mr. Smith of a solid silver inkstand, while Mrs. Smith was the recipient of a silver salver.

Book Notices.—"*Proceedings* of the American Institute of Electrical Engineers." Vol. XXXVI, No. 12. December, 1917. New York: The Institute. Price $1.

"Science Abstracts, Sections A and B." Vol. XX, Part 12. December 31st, 1917. London: E. & F. N. Spon, Ltd. Price 1s. 6d. each.

"Elementary Mathematics and their Application to Wireless Telegraphy." By S. J. Willis. London: The Wireless Press, Ltd. Price 3s. 6d. net.

"Engineering Mathematics." By C. P. Steinmetz. London Hill Publishing Co. Price 12s. 6d. net.

"The Silewani-ghat Hydro-Electric Power Project in the Chhindwara District." By E. Batchelor. Allahabad: The Pioneer Press. Price 2 rupees.

"Short Logarithmic and Other Tables." By W. Cawthorne Unwin. London: E. & F. N. Spon. Price 1s. 6d.

Liquidations. — ARMORDUCT MANUFACTURING CO., LTD.—Creditors must send in particulars of their claims, &c., to Mr. J. Paterson, 1, Walbrook, E.C. 1, Controller, by February 1st.

ROTHERHAM ELECTRICAL ENGINEERING CO., LTD.—A petition for the winding up of this company has been presented by Mr. J. Grout, of Hastings, and is to be heard at Sheffield on January 24th.

TURNER & BURGER, electrical accessories merchants, London, E.C.—The controller, Mr. J. E. Percival, has applied to the B. of T. for his release.

CLIMAX STOPPER AND EBONITE CO., LTD.—Meeting of creditors, January 28th, at Great Eastern Hotel, London, E.C.

Trade Announcements.—MESSRS. W. T. HENLEY'S TELEGRAPH WORKS CO., LTD., announce that the address of their Birmingham branch is now Broad Street Chambers, Birmingham, instead of Edmund Street.

Mr. Chas. Melvin, who has been discharged from the Forces, has started business at 70, Westcombe Hill, Blackheath, S.E. 3, as CHAS. MELVIN & CO., for the sale of electric lamps, torches, batteries, fittings, &c. He asks for calendars and showcards from electrical manufacturers of these lines.

The Edison Battery Co. (U.S.A.).—THE EDISON BATTERY CO., of Orange, N.J., U.S.A., is increasing its capital from £700,000 to £1,000,000.

Bankruptcy.—G. E. HIPKINS, electrical engineer, Dudley.—Application for discharge to be heard on February 5th, at Dudley.

C. B. OGILVIE, electrical engineer, Whalley Range, Manchester.—Trustee, Mr. J. G. Gibson, released January 7th.

SMITH, W. T., electrical and mechanical engineer, Bolton.—Receiving order made January 9th on a creditor's petition.

Calendars.—We have received from MESSRS. PIRELLI, of 144, Queen Victoria Street, London, E.C., one of their wall cards for 1918, a graphic representation of their tires in the motor service of the Italian Forces appearing above a block of daily slips with the date in large red figuring. The firm will be pleased to send a calendar to any of their business friends who may have been overlooked.

From MESSRS. HOME & ROWLAND, Troughton Road, Charlton, S.E., we have received a quite artistic little desk calendar, with tear-off quarterly date slips, each bearing a coloured representation of vessels at sea—in peace-time.

Concert.—The employés of the Phœnix Dynamo Co. gave a concert in the Central Hall, Bradford, on Saturday last, in aid of Relief Fund and the Wounded Soldiers' Fund. The orchestra and most of the artistes were drawn from the employés themselves, and the affair was a pronounced success. The workpeople from these works have been very active in their charitable relief work during the war.

Sweden.—A new company has lately been formed in Sweden to establish works at Västerns for the electrolytic production of copper, nickel and cobalt.

Catalogues and Lists.—MESSRS. COLE, MARCHENT AND MORLEY, LTD., Prospect Foundry, Wakefield Road, Bradford.—Catalogue No. 52 (32 pp., art paper), containing descriptive illustrated matter relating to their slow-speed horizontal steam engines, with piston-drop valves operated by detent gear for superheated or saturated steam. All the main parts of the engines are illustrated, and a general specification and tables of standard sizes are given.

BRITISH INSULATED AND HELSBY CABLES, LTD., Prescot.—Pamphlet P. No. 149, gives brief illustrated particulars and prices of Prescot fuse-boxes (Home Office type).

LIGHTING AND POWER NOTES.

Accrington.—The Trades and Labour Council has passed a resolution disagreeing with the suggestion of the Coal Conservation Committee that electricity supply should be left in the hands of private enterprise, and expressing the opinion that it should be owned and controlled by the nation.

Ashton-under-Lyne.—The Corporation has granted a war bonus of 12s. a week over pre-war wages to its employés; Heywood Corporation has given a similar increase, and Blackpool Corporation has agreed to a 16s. war bonus in the gas and electricity departments, and 14s. in the others.

Australia.—The Sydney City Council Electricity Committee recommends that, owing to the restrictions of window and shop lighting, the monthly charge for arc lamp hire only be reduced to 1s. 8d. per lamp per month during the period the arc lamps are not in use.

The Sydney Electricity Committee also recommends that in connection with the supply of electricity to consumers without meters as a temporary measure, the following schedule of charges be approved:—Lighting, varying from 6d. to 2s. 8d. for every 40-watt lamp, or smaller, per month, and for larger sizes *pro rata*. Power from 1s. 10d. to 7s. 9d. per KW. connected load per month (factories based on eight hours' daily working).—*Tenders.*

Tenterfield (N.S.W.) Electric Lighting works were opened recently by the Mayor, Ald. W. F. Stewart, and the light switched on. In the course of his remarks the Mayor stated that the cost amounted to £8,000, being £2,000 above the original estimate, owing to the increased cost of machinery.

Ballymoney.—E.L. PROPOSAL.—At the monthly meeting of the Council, the secretary of the local gas company wrote that the charge for lighting would be 7d. per unit and half that for power. Mr. J. M'Clenaghan, electrical engineer, who has a lighting scheme under consideration, wrote that he would supply electric light at 7d. per unit, with a sliding scale based on annual consumption, regulated by discounts for large consumers, and 5d. per unit for power. A proposal to allow Mr. M'Clenaghan to erect poles in connection with his scheme was negatived.

Barnes. — PROPOSED EXTENSIONS. — The electrical engineer has submitted plans and an estimate for the projected extension of the works, together with a report which estimates the cost under present circumstances at £12,500; the matter was referred to a Sub-Committee.

Bradford-on-Avon.—The time for making the transfer authorised in the Electric Light Order of 1914 is extended to January 30th, 1919.

Bristol.—PROPOSED EXTENSIONS.—A special meeting of the T.C. was held, last week, to consider a report from the Electrical Committee asking for permission to raise further capital for extensions. Special interest was centred in the meeting, due to a letter having been inserted in the local Press by Mr. Chas. Wills (a former chairman of the Electrical Committee but now in the ranks of the Anti-Municipal Traders) calling upon every member of the Council to vote against the adoption of the report. The report was for the provision of a 6,000-KW. turbo-generator and accessories, together with four boilers. In presenting the report, Alderman Pearson expressed surprise that Mr. Wills did not communicate with the staff to obtain some information with regard to the present application to spend £76,000; had he done so, it was unlikely the Council would have been troubled by his letter. In 1914 they applied for sanction to install a 6,000-KW. set. Owing to the energies of the opposition, it was refused, and a 3,000-KW. set only authorised by the B. of T. They had room in the building for a 6,000-KW. set, but could not put two 3,000-KW. sets in the same site. Hence they had wasted the ground in the works. In addition, they were now compelled to get the larger plant, and it would cost them £10,000 more than three years ago. They had also to find a site for it; £10,000, therefore, did not measure their loss.

Burley-in-Wharfedale.—The Council is supporting the Keighley Corporation in opposition to the Yorkshire Electric Power Co.'s Bill, and has intimated willingness to join with the Urban District Councils' Association, or any other organisation, in opposing the same. The Council has also decided to support the resolutions of the Rural District Councils' Association against the Provisional Order applied for by the Electrical Distribution of Yorkshire, Ltd.

Cheltenham.—PRICE INCREASE.—The electricity charges, which were increased by 5 per cent. last May, are now to be raised another 10 per cent.

Continental.—TURKEY.—According to a report from Constantinople, received through a neutral country, a good deal of speculation in land is just now taking place in both European and Asiatic Turkey, in view of the industrial developments that are expected to take place when the war is over. This is said to be particularly the case at Smyrna, at Konia, and at Eskichir, where, in the case of the last two-mentioned towns, projects for the establishment of central electric lighting stations and tramways are stated to be under consideration. A new electricity station is also in course of construction at Liban, while at Karahissar, the junction town on the Anatolian and Smyrna Railways, a company has lately been formed with a capital of T£500,000 to establish electricity generating stations, sugar works, and tanneries in the district.

Cromer.—PRICE INCREASE.—The Council has agreed to an application by Messrs. Edmundsons to increase the charge for electricity for lighting from 2½d. to 4d. per unit.

Harrogate.—The Ministry of Munitions and the secretary of the Municipal Electrical Association having informed the Corporation of the intention of the Government to stop further extensions of electricity supply except for munitions and national purposes, the Lighting Committee has decided to protest against what it regards as arbitrary interference with the conduct of local electricity supply.

Lewes.—ELECTRIC PUMPING.—The T.C. has decided to install an electric motor at the Pinwell pumping station, at a cost of £80.

London.—MARYLEBONE.—The working of the Council's electricity department for the September quarter shows that 2,873,308 units were sold, a net increase of 127,827 units, or at the rate of 4·65 per cent. over September, 1916. The revenue from consumers, including meter rentals, amounted to £29,588, an increase of £1,275. The generation costs show a decrease of 1·3 per cent. Distribution expenses per unit have dropped from ·171d. to ·165d., or practically down to the 1914 level, in spite of the wages increase. The balance available for capital charges, &c., amounts to £14,539, as compared with £14,405 for the September quarter,

1916. For the half-year to September 30th the available balance is £32,061, as against £32,350 for the half-year to September, 1916, a reduction of £289. As the capital charges are estimated to be £1,400 less than last year, the position is considered very satisfactory, though increases in expenditure are inevitable in later statements. At the same time, there has been an increase in sales during the past few months.

SOUTHWARK.—ANNUAL REPORT.—The accounts of the electric light undertaking for the year ending March 31st, 1917, show a net loss of £8,361, chiefly accounted for by the increase in cost of coal and other commodities, &c., restricted lighting, daylight saving and the earlier closing of shops. The loss for the year shows an increase over the previous year of £1,983. The number of units sold shows a decrease of 135,647, or 5 per cent. on last year's figures, but the income from the private supply (lighting and power) improved owing to the advance in price, the increase being £3,291; public lighting fell to £1,207 from £3,619 in 1913, and after deducting £586 for maintenance, there was left £620 as revenue from public lighting, barely sufficient to cover capital and stand-by charges on this supply. Sales and repairs to consumers' apparatus fell from £1,115 to £865. Prices had already been raised, and all consumers would come under the coal clause as from the 1st prox., except those on the lighting sliding scale, and these would be included at the commencement of the next financial year. The Newington Electric Lighting Order provided that any deficiency of income in any one year was required to be charged upon, and payable out of, the local rate, and provision had been provided in the current year's estimates to meet an estimated deficit of £8,000.

STEPNEY.—The B. of T. has notified its approval of the agreement entered into between the B.C. and the Bethnal Green B.C., *re* hiring and maintenance of electric motors, fittings, and apparatus to consumers in the borough of Bethnal Green. The Electricity Committee recommends the purchase of an apparatus for filtering oil from the high-tension switch tanks and turbines at a cost of £157. The Committee also recommends the Council to dispose of the stock of arc lamps and fittings now in store, as it is highly improbable they will be reinstated in view of the use of the half-watt lamp.

The Finance Committee recommends the Council to make application to the L.C.C. for a loan of £4,153, at 5½ per cent., for the purposes of the electricity supply undertaking.

HAMMERSMITH.—The Electricity Committee reports a net profit of approximately £2,500 on the past year's working (to March, 31st, 1917) of the electricity undertaking. The Committee recommends that, owing to the increased risk of damage by fire, the insurance on the buildings at the electricity works be increased to £125,000.

Manchester.—WAGES.—At last week's meeting of the T.C., Mr. W. T. Dagnall, chairman of the Electricity Committee, asked the town clerk whether the latest award of the Committee on Production would apply to the workers in the electricity department. Lately there had been several awards, and he did not know under which one they would have to pay. They would certainly have to hand out more money to the workmen, and, as a result, there would certainly have to be another increase in electricity charges.

The town clerk, in reply, held that though there was a doubt as to whether the electrical workers were included in the recent award, he advised that they should recognise the award.

Market Drayton.—PUBLIC LIGHTING.—The U.D.C. has acccpted an offer from the Electricity Co. to take £65 in settlement of its account of £100 in respect of public lighting up to the end of 1917.

Newcastle-on-Tyne.—At a meeting of the Newcastle-on-Tyne and Gateshead Chamber of Commerce on the 9th inst., Mr. H. W. Clothier presented a report of a Committee which had been sent to the B. of T. regarding the question of electric power supply in Northumberland and Durham. The report stated that the Committee had taken evidence from 41 consumers, large and small, in the two counties. "The evidence given by these witnesses is unanimously to the effect that they are entirely satisfied with the supply of electricity for their various purposes provided by the electricity supply undertakings of this district. These witnesses stated that they had no complaints whatever to make, and that they were met by the supply undertakings in every possible manner as regards their requirements. The use of electricity has enabled them to effect economy, owing to the low cost of current and the adaptability of its use, thus making further industrial developments possible. The Committee has noted the restrictions imposed by legislation in the past, particularly in the Electric Lighting Acts of 1882 and 1888, and the Power Acts of 1900 and onwards, which have had the effect of restricting the development and prejudicing the supply of cheap electrical energy. The Committee considers that such restrictive legislation should be amended. The Committee is strongly of opinion that in any future legislation which may prove necessary in other districts, much could be gained by a study of the existing conditions in Northumberland and Durham, where the fullest advantage is taken of the resources available. It is also of opinion that in no case should future legislation prevent the making of any mutual arrangement between consumer and supplier which may appear to both to be a commercial proposition." The report was confirmed.

New Zealand.—The Wellington Electric Tramways and Lighting Department's annual report shows that tramway receipts for last year amounted to £207,916, compared with £197,964 in the previous year; working expenses were £145,385, against £118,817; capital charges were £43,601, against £41,927; and the net surplus was £18,960, against £27,120. The expenditure on new works last year was £41,571. The total capital expenditure to March 31st last was—on tramways, £752,455; power supply, £34,721; lighting, £12,182. Receipts from power supply during the year totalled £15,540, compared with £12,763 in the previous year, and the net surplus was £1,729, against £1,306. The passengers carried by the tramway show a daily average of 88,235. The difficulties in obtaining materials hampers construction of rolling stock to meet the demands of traffic.

A Bill has been submitted to the House of Representatives, called the "State Supply of Electrical Energy Bill," to define how accounts in connection with the sale of electrical energy are to be kept. The Bill provides for depreciation, sinking, and reserve funds. The depreciation fund is to be established by annual appropriations of not less than 2 per cent. of the capital cost of the completed works, but the fund is not to exceed one-eighth of the capital cost. Payments at the rate of 1 per cent. are to be made into each sinking fund, but the fund is not to exceed the amount of surplus profits derived from the scheme; any balance of profits is to be credited to the reserve fund.—*Auckland Weekly News.*

Nottingham.—PROPOSED LOAN.—Last week the City Council had before it a report from the Electricity Committee recommending the Council to apply for the consent of the L.G.B. to the borrowing of £20,000 for the extension of the electrical plant. The Committee states that the demand for the extension arose in consequence of an application for a supply of electricity to a factory at Basford doing national work. Subject to consent, the City Council has agreed to install plant at the St. Ann's Well Road Station, and to lay the necessary cables to enable it to give the supply in bulk.

Portrush.—E.L. PROPOSAL.—At the weekly meeting of the Council, the desirability of introducing electric light was discussed. The clerk said that the loan for doing so could be easily got, as the person who had previously promised the loan had plenty of money.

Rawdon.—The U.D.C., last week, supported the opposition of a considerable number of Yorkshire local authorities to the Yorks. Electric Power Co.'s Bill in Parliament, on the ground that its powers would grant an unfair monopoly to the company.

Salford.—A breakdown occurred on Thursday morning, last week, at the Corporation electricity works, as a result of which the main supply was cut off for half-an-hour. The tramways were held up, and the works where current is used for power were stopped, considerable inconvenience being caused.

At a meeting of the T.C. it was announced that the Electricity Committee proposed to give £156 to the local Red Cross Hospitals, instead of allowing them a free supply of electricity. It was expected that this plan would result in a saving to the rates.

South Crosland.—The U.D.C. has under consideration the proposal of the Yorkshire Electric Power Co. to apply for Parliamentary powers to include the township of South Crosland in the area to be supplied.

Spenborough.—PLANT EXTENSIONS.—At a meeting of the Council, it was reported that the Ministry of Munitions had recommended the L.G.B. to grant the Council's application for sanction to borrow £8,217 for electricity extensions, and that a local inquiry was not considered necessary. Sanctions had been issued for £3,999 for buildings, repayable in 30 years; £3,888 for rotary converter and switchgear, repayable in 15 years; £160 for cables, repayable in 25 years; and £115 for meters, &c., repayable in 10 years. The Council is having a detailed statement prepared of income and expenditure, with a view to a general revision of existing electricity charges.

St. Anne's-on-Sea.—Mr. Clothier, electrical engineer to the U.D.C., reports that the crankshaft of another of the engines broke recently, thus putting two engines out of commission. With the remaining engines it was impossible to get the full supply, and the street lighting had been curtailed in consequence, whilst the Tramway Co. had to obtain its afternoon and evening supply from Blackpool. There had been considerable difficulty in maintaining a sufficient steam supply. It has been decided to confer with the L.G.B. and the Ministry of Munitions as to the provision of an additional boiler.

Stourport.—The U.D.C. has referred to a Committee the question of opposing the Shropshire, Worcestershire, and Staffordshire Electrical Power Bill, with the object of protecting the interests of the town.

Swansea.—At the last meeting of the Electricity Committee reference was made to the electric lighting recently installed in the houses on Trewyddfa Common. Councillor Richards referred to the fact that when the installation of electric light in these houses was first suggested some doubt was expressed as to the advisability of that course. Events had proved that there had been no necessity for those fears, and the occupiers of the houses were in every way satisfied, and were thinking of having electric cooking and heating installed.

Walsall.—An agreement is to be entered into with the West Bromwich Spring Co. for a supply, at an estimated capital cost of £270. A 200-K.V.A. transformer is to be purchased, at an estimated cost of £250.

Warminster.—The time for making the transfer authorised in the Electric Light Order of 1914 is extended to January 30th, 1919.

Waterford.—The Corporation has agreed that £300, on account of his claim of £886, be paid, without prejudice, to Mr. E. M. Lacey in respect of services in connection with the city electric lighting scheme.

Watford.—PROPOSED LOAN.—Sanction to a loan of £17,800 for additional plant is to be applied for by the U.D.C.

West Hartlepool.—LINKING-UP.—Inquiries for power having been received from large local consumers, the Electricity Sub-Committee recommends that negotiations be proceeded with for linking-up with the Cleveland and Durham Electric Power Co.'s system, or in the alternative that extensions be made at the Seaton station. Previous negotiations with the Power Co. fell through; at the present time the Council is forced to use the plant at the old station, which is not modern.

Weymouth.—PRICE INCREASE.—The B.C. has increased the charge for electricity by ½d. per unit.

Owing to difficulties, it has been decided to shut down the destructor.

Yorkshire (West Riding).—The West Riding County Council is to obtain the views of the West Riding District Councils' Association, and of the Municipal Borough Councils in the area, on the Yorkshire Electric Power Co.'s Parliamentary Bill. The West Riding Council appears to regard the Bill as giving the company an undesirable monopoly.

TRAMWAY AND RAILWAY NOTES.

Australia.—The Queensland Government has introduced a Bill to provide for the purchase of the authorised tramways in Brisbane and South Brisbane; the franchise of the Brisbane Tramways Co. expires in September, 1920. The proposal is that the Government would issue debentures at 4½ per cent., redeemable in 21 years.

Burnley.—The Tramways Committee has been approached by the local branch of the Amalgamated Association of Tramway and Vehicle Workers, with a view to the formation of a Joint Board on the lines of the Whitley Report. The Committee is favourably disposed to the proposal, and has invited the Association to submit details of the scheme.

Canada.—The British Columbia Electric Railway has received particulars by cable that the Fraser Valley district has been visited by a severe blizzard followed by heavy rains. This caused a coating of ice to form on all telegraph, telephone, light, power, and trolley wires, about 3 in. in diameter, and resulted in the collapse for great distances of the lines and poles. The district was covered by 6 in. of solid ice when the extreme moderation of the weather caused a sudden thaw, which resulted in the overflow of rivers and the flooding of all low-lying country. The company is as yet unable to state the cost of repairs, but it will probably be about $100,000.—*Financial Times.*

Continental.—SPAIN.—Application has lately been made for a concession for the construction and working of an electric tramway between Tarragona and Valls.

Dronfield.—The Derbyshire County Council has formally refused consent to the Bill of the Sheffield T.C. to construct tramways to Dronfield.

Keighley.—RAILLESS TRACTION.—The Corporation railless traction service is in difficulties in regard to getting repairs executed. Of the 10 cars in the service only two are now in commission at present, which means that the recent one-car service on each of the three routes is reduced to a one-car service on two routes and no cars on the Oakworth route. The motors, enclosed in the rear wheels, are said to be the cause of the trouble, and, had they not been interchangeable, the service would have been in worse straits before now.

Lancashire and Cheshire.—WAGES.—The various tramway authorities in Lancashire and Cheshire have received official application from the Employés' Union, asking for a further war wage advance of 10s. per week for male members and 13s. per week for female employés over 18 years of age. At present the men are receiving 12s. a week advance and the women 9s., and if the new application is granted all employés over 18 years of age will receive 22s. over pre-war wages. For those under 18 an advance of 11s. is asked. Accompanying the application was a 21 days' notice to cease work, unless the demand is granted, or the case referred to arbitration by the Committee on Production. The latter course has been adopted.

Leeds.—The sudden snowstorm on Tuesday evening, last week, held up the city tramway service for a considerable period, particularly in the out-districts. A long string of cars was held up in Briggate and Boar Lane for half an hour. The special snow plough cars and cars with revolving brushes had to be brought out, and it was not until about 1 a.m. that the whole system was cleared and the last car got back to the depôt.

London.—An agreement has been come to between the London United Tramways Co. and the L.C.C., for the purchase by the latter of the company's undertaking in Hammersmith, at a cost of £235,000, in satisfaction of all items included in the Arbitrator's award of February 12th, 1912. The money is to be paid on or before the expiration of a year from the termination of the war, and the company until then retains the tramways and receipts.

Morecambe.—PROPOSED ELECTRIC 'BUSES.—The T.C., considering an overhead electric tramway system to be too costly, has decided, with the permission of a ratepayers' meeting, to promote a Bill for the adoption of electric 'buses to run in conjunction with the old horse cars, so that the public can have the choice of vehicles. The Bill asks for £28,000, but it is only expected to spend about £3,000 at first, having two cars as a trial on the town's sea front. For future purposes the Bill covers all the surrounding district—Heysham, Carnforth, Lancaster rural area, and a number of places in Lunesdale. There has been some little opposition to the Bill on the part of the local motor char-a-banc owners.

Southend-on-Sea.—ELECTRIC VEHICLES.—The electrical engineer is to report upon the question of obtaining electric wagons for use in connection with the cartage of coal to the electricity works.

Messrs. Ransomes, Sims & Jefferies recently informed the Council that it would be necessary to increase their quotation for electric dust vans; it was mentioned in Council that the L.G.B. had refused to sanction a loan of £4,150 for these vehicles, on the ground that circumstances were not sufficient to justify it at present.

Swansea.—The T.C. has applied to the B. of T. for an extension of time to August 28th, 1919, for the completion of three systems under the Light Railways Extensions Order, 1914.

The engineer has reported that the delays in the tramway service are not due to the Corporation power-station plant, but to the defective overhead system and cars of the Tramway Co. The latter is unable to obtain materials and labour to cope with maintenance and repairs.

TELEGRAPH AND TELEPHONE NOTES.

A Motor-Cycle Wireless Telephone Outfit.—News comes to hand from the United States that an entirely new form of motor-cycle wireless telephone outfit, the invention in part of Capt. F. E. Evans, of the Corps now in charge of recruiting in New York, is at present being tested by the U.S. Marine Corps. It is stated that the generator forms an integral part of the motor-cycle, and that when it is desired to communicate with an aeroplane or field wireless telephone station, all that is necessary is to lower a frame, which raises the rear wheel of the machine clear of the ground, and then move a lever, which connects the engine to the generator through the medium of a worm drive. The outfit, including the aerial, which is of fine steel, and jointed like some fishing rods, is stated not to exceed a weight of 12 lb. complete, and, it is added, that it can handle messages over a distance of from 50 to 100 miles. Tests made with the outfit are said to have proved that skilled men can have the entire apparatus connected up and ready to receive messages in from 1½ to 2½ minutes.

Argentina.—The wireless station erected by the Ministry of Marine at San Julián was opened to public service in October last year; it has a range of 500 km., thus considerably reducing the time for transmitting messages between the extreme south of the continent and Buenos Ayres. When the station at Punta Delgada is completed, the whole coast of Patagonia will be placed in wireless communication.

Broken Insulators.—During the hearing of a case at Lytham, last week, it was stated that in 1916 3,600 telegraph insulators on main lines in the Preston section were broken, costing £577 for repairs. Last year, in consequence of prosecutions, the number dropped to 1,500.

Great Western Railway.—During the past year a total length of 3¾ miles of air-space telegraph cable was laid by the signal department of the Great Western Railway, as against 5½ miles in 1916. The number of accumulators recharged for working track circuits, electric signals, &c., increased during the same period from 45,000 to 53,000.

CONTRACTS OPEN AND CLOSED.

OPEN.

Argentina.—February 23rd. Rosario Municipality. Establishment of telephone service within the municipal radius. Conditions on application.

Australia.—MELBOURNE.—April 5th. Department of the Navy. Motor-driven hydraulic pump. Director of Navy Contracts, Melbourne.

February 2nd. Waterworks department. Electrically-driven radial arm crane. See "Official Notices" January 4th.

ADELAIDE.—Febuary 27th. P.M.G.'s Department. Telephone material. Schedules 479 and 483. See "Official Notices" to-day.

Manchester.—January 22nd. Corporation Tramways. Block tin. J. M. McElroy, Manager.

Spain.—January 29th. Municipal authorities of Zamora. Concession for the electric lighting of the town; no definite period mentioned. Tenders have lately been invited for the concessions for the electric lighting of the towns of Villarain and Posada (both in the Province of Cordoba), the concession in the first case being for ten years and in the second for three years.

CLOSED.

London.—STEPNEY.—Electricity Committee. Accepted tender. E. Foster & Co. 1,200 tons of Snibston nutty slack, at 23s. 2d. per ton.

HAMMERSMITH.—The Electricity Committee recommends that the existing contracts for the supply of coal be renewed where the prices can be arranged without increasing the cost under the controlled prices at present fixed.

New Zealand.—WELLINGTON.—The Public Service Tender Board has accepted the following tender for 30,000 dry cells for telephones: Messrs. Ellis & Co., Ltd., £1,859.—*New Zealand Shipping and Commerce.*

DUNEDIN.—Electric lighting of new cathedral, £1,055, Messrs. Turnbull & Jones, Ltd.

Salford.—Electricity Committee. Accepted tender. British Westinghouse Co., Ltd. Plant required in connection with the supply of electrical energy at Messrs. J. Mandleberg's new works, one 300-K.V.A. transformer, £350, and one E.H.T. switch cubicle, £265.

Walsall.—The Town Council has renewed its contract with Callender's Cable Co., Ltd., for the supply of rubber-covered cable. The following quotations have been accepted by the Council for the purchase from the Council of plant:—

Levenstein, Ltd.—Babcock boiler, Weir pump and two coal elevators, £3,050.
Ellerbeck Collieries, Ltd.—1,000-KW. generating set and spare parts for turbo-generating sets, £670.
Clay Cross Co., Ltd.—Harris-Anderson purifier, £220.
John Shannon & Son, Ltd.—Weir feed pump, £100.

Wolverhampton.—T.C. Accepted tenders:—

General Electric Co.—Converter plant, £2,792.
Brush Electrical Engineering Co.—Two 300-K.V.A. oil cooling transformers, £326.

[FORTHCOMING EVENTS.

Institution of Mechanical Engineers.—Friday, January 18th. At 6 p.m. At the Institution of Civil Engineers, Gt. George Street, S.W. Papers on "Traction on Bad Roads or Land," by Mr. L. A. Legros, and "Utility of Motor Tractors for Tillage Purposes," by Mr. A. Amos.

Junior Institution of Engineers.—Friday, January 18th. At 6 p.m. At 39, Victoria Street, S.W. Paper on "Power Plants, Maintenance, and Advantages of Steady Running," by Mr. R. Rankin.

Salford Technical and Engineering Association.—Saturday, January 19th. At 7 p.m. At the Royal Technical Institute. Presidential address and musical social evening.

Royal Society of Arts.—Monday, January 21st. At 4.30 p.m. At John Street, Adelphi, W.C. Cantor Lecture on "High Temperature Processes and Products," by Mr. C. R. Darling. (Lecture I.)
Wednesday, January 23rd. At 4.30 p.m. Paper on "Water Power in Great Britain (with special reference to Scotland): its Amount and Economic Value," by Mr. A. Newlands.

Institution of Post Office Electrical Engineers (London Centre).—Tuesday, January 22nd. At 4 p.m. At the Royal Society of Arts, John Street, Adelphi, W.C. Paper on "The Metric System for the Empire," by Mr. A. J. Stubbs.

Institution of Civil Engineers.—Tuesday, January 22nd. At 5.30 p.m. At Gt. George Street, S.W. Papers on "Rail Creep," by Mr. F. Reeves, and "Creep of Rails," by Mr. H. P. Miles.

Institution of Electrical Engineers.—Thursday, January 24th. At 6 p.m. At the Institution of Civil Engineers, Gt. George Street, S.W. 1. Paper on "Telephone Exchange Transfers and their Organisation," by Mr. F. G. C. Baldwin.
(**Students Section**).—Tuesday, January 22nd. At 7 p.m. At Finsbury Technical College, Leonard Street. Paper on "The Evolution of the Thermionic Valve," by Mr. L. R. Smith-Rose.

Greenock Electrical Society.—Thursday, January 24th. At 7.45 p.m. At 22, West Stewart Street. Paper on "Direct-Current Machine Faults," by Mr. J. A. Kinnaird.

Physical Society of London.—Friday, January 25th. At 5 p.m. At the Imperial College of Science, South Kensington, S.W. Ordinary scientific meeting.

Royal Institution of Great Britain.—Saturday, January 26th. At 3 p.m. At Albemarle Street, Piccadilly, W. Paper on "The Chemical Action of Light" (Lecture II), by Prof. W. J. Pope, F.R.S.

OUR HALF-YEARLY INDEX.

As it is necessary to effect every possible economy in paper consumption, the Index to Vol. 81 of the ELECTRICAL REVIEW will be supplied only to those who, through the post, specially apply for it. To such it will be supplied for 3d. post free. Any reader or advertiser at Home or Abroad who requires a copy for binding, or for other purposes, is asked to make application therefor promptly to: The Publisher, ELECTRICAL REVIEW, 4, Ludgate Hill, London, E.C. 4.

NOTES.

Foreign Trade.—THE DECEMBER FIGURES.—The official returns of imports and exports during last month contain the following electrical and machinery figures:—

	December, 1917.	*Inc. or dec.*	12 *months*, 1917. *Inc. or dec.*
IMPORTS.			
Electrical goods ...	99,542	− 93,214	− 318,134
Machinery	690,389	+169,728	+ 875,274
EXPORTS.			
Electrical goods ...	187,785	− 50,010	− 1,131,326
Machinery	1,219,694	−435,335	− 791,291

Languages and Business.—In an address delivered before the Modern Language Association, M. Cambon, the French Ambassador, emphasised the necessity for modern languages as part of the equipment of the business man in the coming days. Such knowledge would be more essential than ever in future, because there would have to be much travelling in order that we might energetically and enterprisingly recuperate a war-devastated world. Such travelling was essential in seeking new outlets, and in consolidating useful relationships.

Volunteer Notes.—LONDON ARMY TROOPS COMPANIES, VOLUNTEER ENGINEERS, late County of London Volunteer Engineers (Field Companies).—Headquarters, Balderton Street, Oxford Street, W. 1.

Officer for the Week.—Lieut. P. Bowden.
Next for Duty.—Second Lieut. F. Gaywood.
Monday, January 21st.—No. 3 Company, 6.30—8.30. Recruits' Drill, 6.30—8.30. Signalling Section, 6.30—8.30.
Tuesday, January 22nd.—Lecture on "Demolitions," 6.30. Physical Drill and Bayonet Fighting, 7.0.
Wednesday, January 23rd.—No. 1 Company, Entrenching, &c., 6.30. Recruits' Drill, 6.30.
Thursday, January 24th.—No. 2 Company, Entrenching, &c., 6.0 Recruits' Drill, 6.30. Signalling Section, 6.30—8.30. Ambulance Section, 6.30—8.30.
Friday, January 25th.—Musketry, 5.30—8.0.
Saturday, January 26th.—Musketry, 2.45—4.45. Knotting, &c., for the whole corps, 2.45—4.45.
Sunday, January 27th.—Commandant's Parade at Waterloo Station, 8.45, opposite No 10 Platform. Uniform, haversacks, water-bottles and mugs. Mid-day rations to be carried.

(By order) MACLEOD YEARSLEY, *Capt. and Adjutant.*

The Wages of Electrical Employes.—The meetings and discussions which have been held during the past four months with regard to the wages of electrical workers have at last resulted in the issue of a definite award by Sir George Askwith, the Chief Industrial Commissioner; and although some minor questions still await settlement, the principal problems have been solved in accordance with the invariable practice of the Government in war time—namely, by acceding to all the demands that are made upon it. The following are the main features of the negotiations, which have been touched upon from time to time in our columns:—The first conference was held on September 6th, with Sir George Askwith in the chair, to consider the claims of the Electrical Trades Union and the National Union of General Workers, and the Association of Municipal Electrical Engineers of Greater London undertook to ascertain the views of the Borough Councils and other municipal authorities that owned electricity undertakings in the metropolitan area. In the meantime, Sir George Askwith suggested that the awards of the Committee on Production, amounting to 15s. advance on pre-war rates, should be extended to the electrical members of the staffs of electricity supply undertakings, as from September 1st. The Conference of Local Authorities met on October 22nd and appointed an Executive Council, which agreed to recommend the adoption of the 15s. award, and this decision was confirmed by the Conference on November 6th, taking effect as from September 1st. But the Trade Unions were out for the additional 5s. award of the Committee on Production and the 12½ per cent. award of the Ministry of Munitions also, and the Executive Committee proceeded to consider these demands. On January 1st a meeting took place between the Committee and representatives of the Electrical Trades Union, the National Union of General Workers, and the National Amalgamated Union of Enginemen, &c., and Electrical Workers, at which the Committee decided to recommend the payment of the additional 5s. as from the first full pay week in December, making the full advance on pre-war rates £1; it was also decided to agree to any further advance awarded by the Government to the engineering and foundry trades, but the question of the 12½ per cent. award was held over.

On January 8th the Electrical Trades Union decided to resort to a strike, in order to enforce their demands by shutting down the generating stations, but were induced to return to work by an assurance that the 12½ per cent. dispute would be settled immediately, and on Monday, January 7th, a Conference was held, under the presidency of Sir George Askwith, to fulfil this undertaking. The Greater London electricity supply undertakings, railways, tramways, and contractors were represented at the meeting, with delegates from the Electrical Trades Union; other Trade Union delegates also attended, but the Electrical Trades Union objected to their presence at the meeting, and apparently succeeded in carrying the point. The Union claimed the 12½ per cent. for all the sections included in their trade card, while the employers' representatives pointed out that they could not deal with this matter owing to the uncertainty as to the classes covered by the award; the latter also urged that, in view of the increases in wages, which seriously affected the costs of electricity supply, the Government should take steps to enable the maximum price to be increased beyond 8d. per unit, and to authorise the revision of contracts with consumers to meet the extra costs.

As reported in our last issue, the Conference lasted for no less than eight hours, and eventuated in the award of Sir George Askwith which we published on page 41 of our last issue. The award relates mainly to the 12½ per cent. bonus, the only specific point which was brought before Sir George Askwith, as the London municipal supply authorities had already practically agreed to pay the 20s. advance, as well as a large number of undertakings in the Provinces; but the corollary to the award—namely, that authority would be given to raise the maximum price for electrical energy, and to revise existing contracts, the necessity for which action arises out of the back dating of the Commissioner's decision to October 13th—was not announced last week.

In an explanatory letter Sir George Askwith refers to questions relating to the interpretation of the award, and states that the decision is of a general character, and is intended to apply to all employés working on plain time in generating and sub-stations, and on mains, or otherwise directly concerned in the generation and distribution of electrical energy, including the technical staffs, throughout the country; it is impracticable to decide in detail how the decision is to be applied to each individual undertaking—each must construe it in a reasonable manner depending on the circumstances, and decide to which members of the technical staff the award should apply. Thus the question which has divided the staffs for so long still remains unsolved—namely, where the line of demarcation between the technical man and the tradesman should be drawn—and a new bone of contention is introduced, for the question arises at once to what rank of the technical staff the award shall extend. As we understand the terms of the award, its upward scope is not explicitly limited; in fact, even the chief engineer of any electricity supply undertaking, no matter how large his salary, could apparently demand and obtain an addition of £1 a week and 12½ per cent. on his salary, as a member of the technical staff; it is, however, absolutely unthinkable, to our mind, that the chief engineer of any important undertaking would take advantage of such an opportunity to enrich himself under existing circumstances, seeing that by so doing he would not only deliver himself bound and gagged into the hands of the Trade Unions which have secured the advance, and of which he ought therefore, in common honesty, to become a member, but would also lay himself open to a reasonable charge of profiteering. The burden of the war should be shared by all classes alike, and those who are already in receipt of salaries sufficient to meet their needs have no right to demand from the community any additional payment.

Another point which arises out of the award is the question whether the men employed, for example, as charge engineers, stokers, &c., in public institutions, such as workhouses, asylums, &c., or in privately-owned factories, in the generation and distribution of electricity are entitled to share in the advance. The award is so wide that we believe they are so entitled, but it will be necessary for them to claim the advance from their employers in the first instance, and if it is withheld, to demand a reference to the arbitration of the Commissioner, as individual cases cannot be adjudicated until an actual difference of opinion has arisen.

As the employés of electrical contractors on munition work are included in the award, which is back-dated to October, it will be seen that contracts carried out and paid for during the past three months will have to be revised, and the purchasers will be called upon to pay the extra cost of labour in such cases.

As for the general aspect of the award, which has been the cause of so much disturbance and unrest, we may point out that it was due to the action of Mr. Churchill, the Minister of Munitions, who, apparently without consulting the Committee of Production which was appointed expressly to handle the question of wages, and has admirably fulfilled its duties, arbitrarily and unwisely gave the 12½ per cent. bonus to certain sections of engineering workers, in ignorance of the existing conditions, with the inevitable result that all other sections of the industry naturally demanded a corresponding increase, and the last state is worse than the first. For thus rushing into a most complex and delicate situation he has been severely taken to task by his colleague, Mr. G. N. Barnes, who, pointing out the disastrous consequences of such a policy, which tends to promote slackness amongst time-workers and to discourage piece-workers, at a time when the maximum output is required, deprecated strikes on the part of men who were earning good wages. Undoubtedly to strike at this time, the crisis of the war, is an unpardonable crime against one's country; the striker is an ally of the Hun, and will, as Sir Auckland Geddes says, deserve the hatred and contempt of his fellow-countrymen.

Clyde Engineers.—The threatened trouble in the Clyde engineering trade over the 12½ per cent. bonus, which is regarded as unsatisfactory by the men, was the subject of a further conference at the Ministry of Munitions on Saturday with representatives of the trades concerned. Objection is taken by the men that the original offer of 6s. 9d. a week made by the Employers' Association, which had in many cases been accepted, is now superseded by the 12½ per cent. bonus. They urged that the 6s. 9d. should be endorsed by the Government if further trouble is to be averted.

The Minister of Labour telegraphed that he had decided to adopt the recommendations of the Trade Union Advisory Committee for the Shipbuilding and Engineering Industry as a basis for the settlement of all outstanding claims arising from the 12½ per cent. order. All applications should be made through the Trade Union Executive, who were the regular normal channels of communication between the Trade Unions and the Ministry of Labour. No application would be referred for settlement so long as a stoppage of work continued.

Mr. G. N. Barnes, M.P., addressed a crowded gathering at Glasgow, on Sunday. He said that during the last few months they had been living on a veritable industrial volcano, expecting day by day to be blown up. The 12½ per cent. had become an obsession on the part of many men in the shipbuilding yards, engineering shops, and other places. These men he placed alongside the profiteers. Every time they struck for higher wages other people were worsened. Those who struck were the comparatively more highly-paid, earning £4 or £5 a week, and every time they struck the currency was diluted, and the prices of goods rose sympathetically, so that the great masses of the poor, including the families of soldiers, had harder lives, and had to bear more than their fair share of the war.—*Daily Telegraph.*

Last Saturday, the Clyde District Committees of the Societies affiliated to the Engineering and Shipbuilding Federation adopted a resolution instructing their Executive Council to call upon the Government to withdraw the new Man-Power Bill before the end of January. Failing this they would ask their Clyde members to down tools. They further asked the Government to call an International Conference to discuss the question of peace.

New Type of Enclosed Motor.—With reference to our article on this subject on page 31 of last week's issue, the address of the Enclosed Motor Co., Ltd., who are the owners of the patents, &c., is Finsbury Court, Finsbury Pavement, E.C. 2.

Cooking Appliances.—A course of three lectures on "The Principles of Fuel Economy in the Design and Use of Cooking Appliances" will be delivered at University College, London, by Mr. A. H. Barker, B.A., B.Sc., on Wednesdays, January 23rd and 30th, and February 6th, at 7 p.m. The lectures are open to the public without fee or ticket. Further particulars may be obtained on application (accompanied by a stamped addressed envelope) to the Secretary, University College, London, Gower Street, W.C. 1.

Institution and Lecture Notes.—Institution of Civil Engineers.—The Council has resolved that its examination in Engineering Drawing, Bills of Quantities, and Elementary Knowledge of Specifications, which is at present an optional subject, shall be after January 1st, 1919, obligatory for all candidates for Associate Membership.

Association of Mining Electrical Engineers.—At a joint meeting of the West of Scotland Branch of the Association and the National Association of Colliery Managers, at Glasgow, on Saturday, a paper was read by Mr. J. H. C. Brooking, on "Cable Complaints."

Birmingham Electric Club.—Mr. J. J. Richardson delivered his presidential address on Saturday last, dealing with the history of electricity and electric lighting.

Appointments Vacant.—Teacher in electrical subjects for classes for training disabled soldiers (£4) for the Croydon Education Committee; switchboard attendant (56s. 3d.) for the Walthamstow electricity and tramways department; junior shift engineer (45s. +) for the Borough of Warrington electricity department; assistant shift engineer (70s.), also switchboard attendant (63s.), for the Borough of Pattersea electricity works; switchboard attendant for the Derby Borough electricity works; meter tester (45s. +) for the Borough of Rochdale electricity department. See our advertisement pages to-day.

Welfare Work at Fullers' Works.—We have received some reports from this firm which show that while the new works are being energetically carried on, the social welfare of the workers is not overlooked; the reports relate to canteen work, allotments scheme, first aid, and the War Saving Fund. We notice that an efficient and handsome canteen will shortly be erected; but what is especially interesting is the fact that a canteen providing light but nourishing refreshments has now been successfully carried on for 10 months without loss, and at the same time has been entirely self-supporting. This fact is useful knowledge for any manufacturer who desires to help his employés without incurring the responsibility of an expensively equipped canteen. The other reports on allotments, first aid, and War Saving Fund are equally interesting and instructive, showing what satisfactory results can be attained by co-operative effort.

National Insurance (Part II) (Munition Workers) Act, 1916.—The following are further decisions of the Umpire. Contributions are payable in respect of:—

2,407 X. Workmen described as valvemen, hydaulic main men, tar main men, and exhauster men engaged wholly or mainly in connection with the operation of by-product plant attached to coke ovens.

2,408 X. Workmen engaged wholly or mainly in the manufacture from rubber or rubber-proofed fabric of gas bags for motor-cars. (Application 502.)

A 2,410 X. Students at technical institutes receiving training under arrangements made by the Ministry of Munitions in any of the trades set out in the Sixth Schedule to the National Insurance Act, 1911.

A 2,411 X. Students at technical institutes receiving training under arrangements made by the Ministry of Munitions in any of the trades set out in the First Schedule to the National Insurance (Part II) (Munition Workers) Act, 1916, or in munitions work.

Electrolytic Production of Zinc in Tasmania.—The *Times* says that satisfactory results are reported from the plant erected at Risden, Tasmania, for the electrolytic production of zinc from Australian ore and concentrates. The plant has a daily capacity of 15 tons, which it is said can be increased tenfold, and the necessary electric power is obtained from the State's Great Bear hydro-electric installation.

The Electrical Trades Benevolent Fund: the Special Appeal.—We have received from the secretary of the E.T.B.I. the following list of contributions received as a result of the special appeal which was made with a view to bringing the invested fund of the organisation up to £10,000. Nearly £200 more is still required, and we trust that further special contributions will be received by Mr. Hawes in the course of the next week or two, so that the trustees can be placed in the position desired :—

Salomons, Sir David	£20	0	0
Vickers, Ltd.	21	0	0
Holmes, J. H.	5	0	0
Tufnell Carlton, F.	3	3	0
Hooper, John P.	10	10	0
Marryat, H.	5	6	0
Christopherson, Clifford & Co.	5	5	0
Hecht, Levis & Kahn	2	2	0
Heilbut, Symons & Co.	10	0	0
Aldens Successors, Ltd.	10	0	0
Frederick Smith & Co.	2	2	0
Callender's Cable and Construction Co.	21	0	0
	£115	7	0

Joint Boxes and Terminals for Split Conductor Cables.—With reference to the article under this title in our issue of January 4th, we are informed that the use of braids for cable jointing is covered by Mr. Charles Vernier's Patent No. 15,413/09.

Fatalities.—A newspaper report says that William Joyce, 63, foreman fitter at the Scarborough Electric Supply Works, ascended to the top of a boiler at the works to look at some seeds which he was forcing, when he appears to have tripped and fallen to the ground. He was found, later, lying dead.

An inquest was held at Southport recently on Celia Clarkson, wife of a soldier, who had been employed as driver of an overhead electric travelling crane at the L. & Y. Railway goods depôt. Evidence was given that on May 4th last the deceased told her mother she was oiling the crane when some electricity "shot out," which seemed to roll her up like a ball, causing her to fall from the cage to the stage below, a distance of 15 ft. She was admitted to the infirmary suffering from a fractured spine and paralysis of the arms and legs, was discharged on November 14th as incurable, and died on January 7th. A witness said it seemed to her that the deceased touched a live wire, but the district inspector thought the woman fainted and fell from the cage. A verdict of "Death from misadventure" was returned, the jury expressing the view that greater precautions should be taken.

Electrolytic Zinc in Australia.—The plant established at Risden, Tasmania, has proved the possibility of the application of the electrolytic process to Australian ores and concentrates for the production of zinc for munitions, heretofore produced within the Empire only in small quantities. M. Balillieu, chairman of the Electrolytic Zinc Co., states that the present plant has a capacity of 15 tons daily, which can be increased tenfold. Competition between the technologists of the Risden electrolytic process and the Port Pirie retort furnacing process has already produced metallurgical improvements.

Electric Light Switching Exams.—Many people may feel amusement at the idea of a private firm holding examinations and issuing certificates in this or any other subject, but the President of the I.E.E. is not one of these, as may be seen from a remark in his address; if these exams. had met with a poor response, it might reasonably have been inferred that the subject was one that did not matter, but us—even in such a time as the present—Messrs. Lundberg are able to show such results as those appearing on another page in this issue, it may certainly be concluded that the subject possesses both utility and interest.

We have had the opportunity of inspecting the papers submitted by some of the top men in each grade of the last examination, and have been very much struck by the amount and high quality of the work done by these premier candidates. It is quite evident therefrom that something beyond the securing of a certificate and a possible book prize must have spurred them on to such efforts in such a busy time as the present. Though many of the examinees, judging from the papers we have seen, are used to examinations, it is certain that the subject prompts many workers to express their ideas of circuit diagrams and other matters on paper for the first time, and these switching exams. should undoubtedly encourage hitherto apathetic individuals to consider the advantages of attending classes in "Electrical-installation Work" at technical institutes, and of proceeding in due course to the examination in that important but somewhat neglected subject. So much neglected is it, that there are to be no City Guilds exams. appertaining to it this session, because of the war. The exam. in "Gas Fitting," however, is to proceed as usual!

OUR PERSONAL COLUMN.

The Editors invite electrical engineers, whether connected with the technical or the commercial side of the profession and industry, also electric tramway and railway officials, to keep readers of the ELECTRICAL REVIEW *posted as to their movements.*

Central Station Officials.—The Swansea Corporation Finance Committee recommends that the salary of the borough electrical engineer, Mr. W. J. BURR, be advanced by £100 per annum.

The marriage has taken place at Richmond-on-Thames of Lieutenant A. J. JAMES, R.N.V.R., who was on the staff of the Bedford Corporation electricity works, and Miss K. Fowler, of Bedford.

Kendal T.C. has increased the salary of the electricity works manager by £20 to £220 per annum.

Hastings T.C. is increasing the salary of Mr. N. J. RYAN, chief assistant electrical engineer, from £180 to £220 per annum, and by subsequent increments of £10 to £250.

Walsall Town Council has sanctioned the following increases of salary:—Mr. C. W. COOKSON, accountant and collector, electric supply department, from £188 to £214 per annum; Mr. JOHN R. TAYLOR, chief clerk, tramways department, £25 per annum.

Wolverhampton Town Council has appointed Mr. CHARLES WILLIAM CHARLESWORTH, of Stoke-on-Trent, commercial secretary to the electricity undertaking at a salary of £300 per annum.

It was mentioned at a meeting of the Kilmarnock Corporation Electric Committee that Mr. BEXON, the engineer, was an applicant for a situation under the Birmingham Corporation at a considerably increased salary. With the view of retaining Mr. Bexon's services it was proposed that he be offered a three years' engagement at a commencing salary of £550 for the first year (being a present increase of £100), to rise £50 at the end of each of the first and second years, making his salary for the third year £650. The Town Council has delayed the matter for a month.

Mr. A. G. DURRANT, of the Great Yarmouth Corporation tramways and electricity departments, has been appointed electrical engineer in charge of new electricity works for Messrs. John Chambers, Ltd., shipbuilders and engineers, to supply their No. 3 Shipyard, and also the Oulton Broad Electricity Co., with power and light. The tramways manager, Mr. F. L. Turner, presented Mr. Durrant with a barometer and thermometer, and he received a writing case and wallet from the electricity works mains department.

On Thursday evening last week a big muster of the staff and employés of the Bristol Corporation electricity department assembled at the Lecture Theatre of the Museum to commemorate the 25th year of service of Mr. H. FARADAY PROCTOR as engineer and general manager of the department. The chair was taken by Mr. F. W. Prosser (secretary and sales manager), who was supported by Mr. A. J. Newman (deputy engineer), Mr. Thos. H. Gait (accountant), and Mr. J. Stapleton (foreman of the Feeder Road electricity works). The chairman traced the history of the undertaking from its inception in 1883. The late Sir William Preece (who was appointed consulting engineer) was instructed to provide an equipment for 20,000 30-watt lamps. The equivalent 30-watt lamps installed to-day is 935,000. The "baby" of the Bristol Corporation had been tenderly nursed, and had come to maturity under the parental guidance of Mr. Proctor, who, despite many temptations of more lucrative appointments elsewhere, had succeeded in placing the department in a most enviable position.

Mr. T. H. Gait, on behalf of the accountancy and clerical staff, tendered sincere congratulations, and voiced the pride and satisfaction of the staff in their "chief" and in the electricity department, and remarked that Mr. Proctor held very prominent positions in the electrical world in connection with the I.M.E.A. and the I.E.E. The I.M.E.A. owed its foundation to Mr. Proctor. Mr. Proctor's attitude towards the staff and employés had always been most generous and kind, especially to those members who were serving with the Forces. Mr. J. Stapleton spoke on behalf of the workmen.

Mr. A. J. Newman, in a brief speech, compared the position of the undertaking 25 years ago with its present position, and gave the following details:—Number of consumers: 1893, 120; 1917, 5,300. Staff and employés: 1893, 30; 1917, 230. He said for one man to "skipper" the good ship "B.C.E.D." to its present enviable position was a very meritorious accomplishment. He asked Mr. Proctor to accept a silver epergne and silver cake tray as a slight token of their loyalty and esteem.

Mr. Proctor, in responding, said he really could not find words in which to express his thanks to those who had arranged the social evening, and for the beautiful articles with which they had presented him. He was grateful to all who had come to mark his 25th year of service with the Bristol Corporation. The day was not very far distant when a site would have to be found for the main generating station, as the water in the Feeder Canal and River Avon would be far too little for ultimate developments. If the recommendations of the Coal Conservation Sub-Committee were adopted it would be just possible that a large station would be erected on the banks of the Severn, where chemical and high explosive, together with spelter works, were being contemplated. The Lord Mayor of Bristol in several speeches he had recently made commented on the Labour unrest, and advocated that the heads of all business establishments should take their staff and employés to their hearts. In the early days of this undertaking it was a great pleasure to him to know every employé by name and something about him, but the increasing growth of the department had unfortunately prevented this in the latter years. It was a matter of great regret to him that he could not come into contact with them more often. He was very glad to say that no serious trouble had ever arisen with any portion of the staff or employés, and he thought this was a fact to be justly proud of. There was

no reason why there should be any trouble. The Corporation had a duty to fulfil in seeing that the conditions under which their employés worked were satisfactory.

Mr. Chas. Hancock (one of the oldest members of the general office) proposed a vote of thanks to the chairman, coupling with it the ladies of the staff who had contributed to the musical part of the programme. The proceedings closed with the National Anthem.

General.—Mr. H. BARGE, engineer at Messrs. Bullivants, Millwall, E., and son of the chairman of the Poplar Electricity Committee, has been appointed Officer of the British Empire.

Mr. G. H. CUTTING, of Messrs. Cutting Bros., Ltd., electrical engineers, of Stamford, has been appointed on the Local Advisory Committee formed to co-operate with Labour Exchanges in dealing with demobilisation, the employment of discharged soldiers, and the substitution of men to take the places of men eligible for the Army.

Vice-Admiral Sir REGINALD H. S. BACON, D.S.O., has been appointed by the Minister of Munitions as Controller of the Munitions Inventions Department in succession to Colonel H. E. F. Goold Adams, C.B.

Indian Engineering states that Mr. C. LANDON, Superintendent of Telegraphs, on expiry of leave granted him on return from field service in East Africa, has been posted to the charge of the Trichinopoly Division; also that Sir WILLIAM MAXWELL, Director-General, Post and Telegraphs, is at present making a tour of inspection in Mesopotamia in connection with postal and telegraphic administration in that area.

Stepney B.C. Electricity Committee has appointed Ald. KILEY Chairman and Coun. KOSKY Vice-Chairman for the ensuing year.

Mr. TOMY THOMPSON, who is the Swansea district engineer for the British Westinghouse Electric & Manufacturing Co., Ltd., is the author of a novel, entitled "Letters to Lady Shesheen," which has lately been published at 5s. net by Messrs. Murray & Evenden, Ltd., 32, Essex Street, W.C.

Mr. E. S. LOWES, the secretary of the Southern Brazil Electric Co., has been appointed manager of the company in London.

Mr. FRANK A. HAMMOND, of Leeds, who at present holds a position under the Nova Scotia Tramways & Power Co., has contributed to the *Yorkshire Post* a long account of the disastrous explosion which occurred at Halifax in December.

Mr. JAMES N. WILSON, the secretary and treasurer of the Glasgow Corporation tramways undertaking, has been appointed secretary of the Tramways Control Committee appointed by the Board of Trade to supervise the whole of the tramway undertakings of the country.

Mr. W. B. WOODHOUSE, chief engineer and manager of the Yorkshire Electric Power Co., is to lecture on coal conservation and the national electricity scheme, and Mr. P. J. PYBUS, Commander of the Order of the British Empire, managing director of the Phœnix Dynamo Co., Bradford, is to lecture on new ideas of factory management, at the Saturday night "talks" at the Dewsbury Central Liberal Club.

Mr. T. W. DUNNING has been appointed Superintendent of Telegraphs at Southampton, in succession to Mr. E. Long.

A New Zealand paper states that Mr. R. W. DALTON, H.M. Trade Commissioner for New Zealand, will return to the United Kingdom after he has completed three years in the Dominion. He will then spend 12 months touring the United Kingdom in order to bring to British manufacturers the benefit of his special knowledge of the business conditions of the Dominion.

Mr. WILLIAM GEIPEL (W. Geipel & Co.) has publicly announced that as from December 10th, 1917, his name is changed to William Guy-Pell.

Mr. J. M. CLARK has resigned his position with the Alloa Corporation to take up an appointment with Messrs. Kelsall and Parsons, 227, St. Vincent Street, Glasgow, agents for the Lancashire Dynamo Co., George Ellison, Laminated Gears, Engineering & Arc Lamps, Ltd., &c.

Amongst the naval officers brought to the Admiralty under the new organisation is Captain NICHOLSON, the head of fleet communication, who was the Wireless Officer of the Grand Fleet, and in that capacity was present at the battle of Jutland.

Roll of Honour.—One of the directors of the Electrical Apparatus Co., Ltd., Captain E. A. GODSON, M.C., of the Royal Irish Fusiliers, has recently been mentioned in the dispatches of Sir Douglas Haig. Major W. ROBERTS, R.F.A., the company's late South Wales representative, has been granted the Military Cross for distinguished service.

Private A. S. CHANTRY, Machine Gun Corps, who has fallen in action, was engaged in the electrical department of the Rotherham Main Colliery.

Brigadier-General MANCE, who was appointed a C.B. in the New Year Military List of Honours, is the son of Sir Henry C. Mance, who has been an eminent member of the electrical profession for so many years.

The *Times* states that Second-Lieutenant A. W. H. PURNELL, R.G.A., who was previously reported as missing, died as a prisoner of war at Winkel St. Eloi, in Belgium, on November 20th, from wounds received on November 13th, aged 24. He was educated at Loughborough Grammar School, subsequently entering the State University at Coethen-in-Anhalt, in Germany, for part of his training in mechanical and electrical engineering. There he took his diploma with honours in all subjects. On his return to England he entered the works of Herbert Morris, Ltd., at Loughborough, of which his father is a director, and in October, 1914, joined the Motor Transport Service.

Brigade-Major F. BARRITT HILLS, R.G.A., who has been awarded the D.S.O., is manager and secretary of the North of Scotland Electric Light & Power Co., Ltd., Montrose.

Amongst the new Members of the Order of the British Empire is Mr. MATHEW ADAM MCLEAN, shop superintendent of the British Westinghouse Electric & Manufacturing Co., Ltd., Trafford Park.

Mr. PHILIP E. PARKER, of Clitheroe, who has been serving as a wireless operator, is reported by the Marconi Co. to have been drowned at sea.

Amongst the new Members of the Order of the British Empire appears the name of Mr. JAMES CONNOR, works manager of Messrs. Dick, Kerr & Co., Ltd., Preston.

Private W. ROSKELL, Royal Sussex Regiment, who has been killed in action, was an apprentice with Messrs. C. T. Briscoe and Son, electrical engineers, Blackburn.

Sapper J. FULLER, R.E., who has been killed in action, was employed by Messrs. J. H. Taylor & Co., electricians, &c., Huddersfield.

Second-Lieutenant G. E. CASHMORE, R.F.A., who recently received the Military Cross at the Investiture at Buckingham Palace, was a member of the staff of the Birmingham electric supply department.

Captain NORMAN TAYLOR, R.E., who has been awarded the M.C., is the elder son of Mr. F. W. Taylor, head of the firm of F. W. Taylor & Co., electricians, Milnsbridge, with whom he was associated in business prior to November, 1914, the time of being gazetted. He is now in Macedonia.

Sapper W. E. GREETHAM, R.E., Cable Section, who is reported to have died in hospital whilst in India, was apprenticed to Mr. G. Newby, electrical engineer, Harrogate.

Captain FORD JONES, who has been honoured with the M.C. decoration, was an electrical engineer in Swansea.

Captain J. STEVEN HAMILTON, of the West Yorks. Regiment, second son of Mr. J. B. Hamilton, commercial manager of the City of Leeds, has been promoted to a captaincy, and made the recipient of the D.S.O. for brilliant services rendered with his regiment in a recent engagement. He was an assistant engineer to the Leeds tramways department. Four of his brothers are also serving (one has been posted missing since May 12th last).

Private W. HARWOOD, Loyal North Lancashire Regiment, killed in action, was on the staff of Messrs. Bullers, Ltd., of Hanley.

Private J. BIDDULPH, Royal Berkshire Regiment, who was with Messrs. Taylor, Tunnicliffe & Co., of Hanley, reported missing, is a prisoner of war in Germany.

Second-Lieutenant J. E. DAVIES, King's Liverpool Regiment, who was an engineer at the Rugby works of the B.T.H. Co., has been promoted to the rank of Lieutenant.

Second-Lieutenant J. E. BASKETT, R.G.A., who has died of wounds, was at the Rugby works of the B.T.H. Co., Ltd.

Captain M. D. CLORAN, R.G.A., holder of the Military Cross, who was on the engineering staff of Messrs. Willans & Robinson, Ltd., Rugby, has been wounded in the thigh, and is in hospital at Manchester.

The death in action is reported of Private W. ROSKELL, Royal Suffolk Regiment, who was in the employ of Mr. T. Briscoe, electrical engineer, of Blackburn.

Mr. WILLIAM NETTLESHIP, who has been granted a commission from the ranks as Second-Lieutenant in the R.F.C. (he is to be Mechanical Equipment Officer), was in business as an electrician, &c., in Bridlington.

Corporal J. BARLOW, lately in the employ of the Stepney B.C. electricity department, has been awarded the Military Medal.

Major GORDON C. KENNARD, R.E., of the Westinghouse Cooper-Hewitt Co., was awarded the Military Cross in the New Year's Honours List, for distinguished conduct in the field.

Private R. C. WHEWELL (21), Royal Scots Regiment, who is already the possessor of the D.C.M. and Military Medal decorations, has been recommended for further honours. He was employed by the Lancashire Electric Power Co.

Mr. CLARENCE SCOTT, of Leeds, leading telegraphist in the Navy, has been drowned at sea.

Corporal A. C. CHAMBERS, who has been killed in action outside Jerusalem, aged 21, after being recommended for the D.C.M., was an apprentice with Messrs. Elliott & Co., electricians, Oxford, when he volunteered for service in 1914.

Second-Lieutenant C. W. CASWELL, Middlesex Regiment, who has been awarded the Military Cross, was with Messrs. Barnett & Sons, electricians, Kettering.

Private A. FROST, Royal Fusiliers, previously reported wounded and missing, is now reported killed in action. He was employed at the Chiswick electricity works.

Staff-Captain WILLIAM ALAN FRASER, D.A.Q.M.G., R.E., reported killed in action, for some time filled an appointment as electrical engineer under the Edinburgh City Council, and was later borough electrical engineer at Lancaster and Nelson. While at Lancaster he volunteered for service in the South African war, and served through that campaign with the Middlesex Yeomanry. Before joining up for the present war he held appointments in America. He had been mentioned in dispatches in this campaign, and was promoted to Staff Captain.

CITY NOTES.

British Columbia Electric Railway Co., Ltd.

Mr. G. P. NORTON presided at the annual meeting last week. He said that the decision to postpone the payment of the interim dividend on the 5 per cent. cum. pref. stock had been made in view of the uncertainty as to the amount of the earnings in the immediate future, and because they could not prudently continue to pay the larger portion of that dividend out of the reserve fund. Since the annual report was issued they had received by cable the statement of income and expenditure for the month of November, showing an increase in gross earnings of $52,862, and in net income of $31,772. Thus the gross earnings for the first five months of the current financial year showed an increase of just under $200,000 over the earnings for the same period of the preceding year, but, unfortunately, the increase in the net income for the five months only amounted to $29,000, or, say, £6,000. They could, however, take some encouragement from these figures, as the increase in gross earnings was due to a very marked improvement in trade and business conditions in British Columbia, which had every indication of being of a permanent character. If, therefore, as a result of the report of the recent commission of inquiry, jitney competition was abolished, and other conditions were fairly adjusted, there was a sound basis on which to build hopes that less difficult times were in store. The policy and prospects of the company were dependent on the result of negotiations now being carried on with the object of bringing about a fair and satisfactory re-arrangement of working conditions, based on the commissioners' report.

County of London Electric Supply Co., Ltd.

The *Financial Times* states that the County of London Electric Supply Co. has deposited a Parliamentary Bill seeking certain financial powers. The preamble recites that in 1913 the company was authorised to acquire a site and erect a generating station in Barking, and it was the intention to raise capital for the purchase of the site and the erection of the station, but, owing to the war, it was not, and will not now be, possible for the company to raise the capital on the terms contemplated prior to the war. The preamble further recites that the company is desirous of placing itself in a position to proceed forthwith, on the conclusion of the war, with the erection of the generating station, and with that object to make all necessary arrangements in advance. The Bill, therefore, proposes to empower the company to "pay out of its capital interest at the rate of 5 per cent. per annum upon any shares and debenture stock issued for the purpose of acquiring the generating station site and constructing thereon the works authorised." The aggregate amount to be so paid for interest is not to exceed £150,000, except with the consent of the Board of Trade. The unissued share capital amounts to £300,000, but the Bill provides that the interest paid out of capital is not to operate as a reduction of the amount paid up on the shares or debenture stock, but is to be "charged by the company to capital as part of the costs of construction of its undertaking."

Kaministiquia Power Co.—For the year ended October 31st last the gross revenue was $380,388, operation and maintenance $55,812, depreciation and renewal reserve $34,000, the net revenue being $290,576. Fixed charges amounted to $96,125, leaving a net income of $194,451. Dividends representing 7 per cent. on the paid-up capital, absorbing $153,720, have been disbursed, and $40,731 has been transferred to surplus account. Since the end of the year the company has received orders for power for new grain elevators, which have been erected, as well as for some industrial plants that have been closed down on account of the war, and are now re-opening. There are also prospects of one or more pulp mills being established in the locality, and if these mature the company will doubtless be called upon to supply the electrical power.—*Financial Times.*

Liverpool Overhead Railway Co.—Final dividend, for the half-year ended December 31st last, at the rate of 5 per cent. per annum, less income-tax, on the preference shares, and at the rate of 4 per cent. per annum, less income-tax, on the ordinary shares, making for the year 5 per cent. on the preference, and 3¼ per cent. on the ordinary shares.

General Electric Co., Ltd.—A financial daily states that in addition to the half-yearly dividend of 6s. per share, paid on the preference shares, less income-tax at 5s., on December 31st, an additional distribution was made of 3s. per share, free of income-tax, representing the income-tax deducted in December, 1916, and June, 1917.

Edison & Swan Electric Co., Ltd.—The resolution for reduction of capital was confirmed at an extraordinary meeting held on January 9th.

Stock Exchange Notice.—Application has been made to the Committee to appoint a special settling day in :—

United Electric Car Co., Ltd.—100,000 7 per cent. cumulative preference shares of £1 each, fully-paid (Nos. 1 to 100,000).

Western Union Telegraph Co.—Extra dividend of 1 per cent., in addition to the regular quarterly dividend of 1¼ per cent.

STOCKS AND SHARES.

TUESDAY EVENING.

PRICES in the Stock Exchange are what the financial journalist delights to call well maintained. The scribe likes to write of cheerful things in matters connected with stocks and shares; George Gissing would have made a disastrous City Editor. There is that in human nature which makes for optimism; a bear is the most timid animal in the Stock Exchange menagerie. So it is pleasant to say that markets are good. That electric railway stocks are materially better. That manufacturing shares are firm as ever. That affairs in Mexico do flatter a faint hope of improving conditions That Stock Exchange business might easily be worse than it is.

Three years have elapsed since the markets were allowed to return to their rightful home, after wandering for five months in the draughty trench called Throgmorton Street. By far the majority of electricity investments stand higher now than they did in those early days of 1915. Badly-shaken confidence has been restored. Companies have found unexpected developments for profitable working. There is money available for use even in directions other than those of feminine luxuries. The war marches to its appointed end, premium bonds or no, and the hopeful folk detect slender shafts of blue far off on the horizon of the war-laden skies. Stock Exchange markets are firm and investments on the rise, in spite of the conviction that a 5s. income-tax and an 80 per cent. excess profits duty may be made to appear, by comparison, but easy burdens when the next taxation scales are announced.

The trio of Central London assented stocks, ordinary, preferred and deferred, rose 2 points apiece to 62¼ on the stimulus of a modest demand. Metropolitan Consolidated also proved to be in short supply and gained ¼. Districts lag behind, and the Underground Electric group keeps steady. Nothing has been published of the expected scheme for an association to look after the interests of railway stockholders south of the Tweed, on the lines of that formed in Scotland for safeguarding railway interests there.

The Metropolitan Railway will announce its dividend on January 25th, while the declarations of the District, London Electric, Central London, City and South London, and the L.G.O. will be made on February 7th.

Brisbane Electric Tramways ordinary have fallen to about £5, and business has been done in the preference to 3¼, on the proposed high-handed action of the Queensland Legislature, as outlined here last week. How to object with any degree of success from this side, those who are interested admit that they frankly are unable to see at present, but it will seem a thousand pities if the Queensland Government pays no heed to the protest made against its scheme.

Colonial tramway shares on the whole are very firm, and the 4¼ per cent. debenture stock of the British Columbia Electric Railway has gained 2 points. The foreign list is also better, with a welcome recovery in Anglo-Argentine Tramways, the first preference at 2 11/16 marking a gain of 3/16, while the 5 per cent. debenture at 66 is also harder. Brazil Tractions advanced a point to 47, and further substantial gains have been secured by Mexico Tramway first bonds at 37, which makes a rise of 10 points in the week, while Mexican Light first bonds at 37 are 4¼ up. On the other hand, the issues of some of the Canadian industrials are lower. Calgary Power shares, for instance, at 27½ are 5 points down, and Canadian Car & Foundry preferred at 65 show a similar drop. The only weak spot in the Mexican group is Monterey 5 per cent. bonds at 26, this being 2¼ lower on the week.

London electricity supply shares are good, with Westminsters at 6¾ securing a 5s. rise. In the manufacturing group, General Electric Ordinary reacted 15s. to 19, although the Preference at 10¾ are ¼ better. India-Rubber shares have again advanced, and a rise of 10s. in Telegraph Constructions took the price to 42, the last-named being due to the dividend announcement. Other manufacturing shares are mostly good, with the exception of British Westinghouse Preference at 2¾. British Aluminium Ordinary have risen to 33s. 1½d.

The telegraph list shows further improvement in the Eastern group, there being rises in Eastern Extensions, Eastern Telegraph Ordinary, and Globe Ordinary. Anglo-American Preferred is dull at 95. The rise in Oriental Telephones is resumed, and the price has hardened to 3¼. Marconis have swung backwards, business in them being quiet again, which has caused the price to revert to 3¼, with Americans a little easier at 25s. A noticeable improvement has taken place during the past few days in practically all the industrials connected with Egypt.

Rubber shares are quiet, without development of further

features; the price of the material has slipped back to 2s. 4½d. per lb. Base-metal shares are mostly better, those in the silver, tin, and copper groups being prominently good. Business throughout the Stock Exchange, as mentioned above, is on the mend, and some of the markets which have been dormant for many a month are finding a moderate amount of activity in their long-neglected shares.

SHARE LIST OF ELECTRICAL COMPANIES.

	Dividend 1915.	Dividend 1916.	Price Jan. 15, 1918.	Rise or fall this week.	Yield p.c.
HOME ELECTRICITY COMPANIES.					
Brompton Ordinary	10	9	6¾	—	£6 18 6
Charing Cross Ordinary	5	5	4	—	6 5 0
do. do. do. 4½ Pref.	4½	4½	3⅝	—	6 13 4
Chelsea	4	3	2⅞	—	5 9 1
City of London	8	8	15½	—	6 0 9
do. do. 6 per cent. Pref.	6	6	10⅜	—	5 16 6
County of London	7	7	11	—	6 7 3
do. 6 per cent. Pref.	6	6	10½	—	5 18 5
Kensington Ordinary	7	6	6¾	—	5 11 7
London Electric	3	Nil	1	—	Nil
do. do. 6 per cent. Pref.	6	4	8½	—	5 6 8
Metropolitan	3	3	2¾	—	4 12 4
do. 4½ per cent. Pref.	4½	4½	3⅝	—	6 13 4
St. James' and Pall Mall	8	8	7	—	5 14 6
South London	5	5	3	—	6 13 4
South Metropolitan Pref.	7	7	21/8	—	6 16 6
Westminster Ordinary	7	7	6¾	+ ¼	5 5 8
TELEGRAPHS AND TELEPHONES.					
Anglo-Am. Tel. Pref.	6	6	95	—½	6 6 6
do. Def.	33/6	1½	28⅜	—	6 8 4
Chile Telephone	8	8	7½	—	5 10 4
Cuba Sub. Ord.	6	7	9½	—	*7 11 4
Eastern Extension	8	8	15⅝	+ ⅛	*5 5 9
Eastern Tel. Ord.	8	8	151¼	+1	*5 5 8
Globe Tel. and T. Ord.	7	7	14	+ ½	*5 0 0
do. Pref.	6	6	10⅜	—	5 17 1
Great Northern Tel.	22	24	86	—	6 11 6
Indo-European	13	13	63½	—	6 3 10
Marconi	15	15	3¼	— 1/16	4 16 1
Oriental Telephone Ord.	10	10	8¼	+ ⅛	3 4 0
United R. Plate Tel.	8	8	6¾	+ 1/16	*5 16 6
West India and Pan.	6d.	6d.	1 1/16	—	*3 9 6
Western Telegraph	7	8	15½	—	*5 5 0
HOME RAILS.					
Central London, Ord. Assented	4	4	62½	+2	6 8 0
Metropolitan	1	1	23½	+ ½	4 5 1
do. District	Nil	Nil	15⅛	—	Nil
Underground Electric Ordinary	Nil	Nil	1⅞	+ ⅛	Nil
do. do. "A"	Nil	Nil	5/8	—	Nil
do. do. Income	6	4	62	—	*4 17 7
FOREIGN TRAMS, &c.					
Adelaide Sup. 6 per cent. Pref.	6	6	4⅞	—	6 8 1
Anglo-Arg. Trams, First Pref.	5½	5½	2 3/16	+ 1/16	—
do. 2nd Pref.	5½	—	2⅜	—	—
do. 6 Deb.	5	5	66	+ ⅛	7 11 6
Brazil Tractions	4	4	47	+1	—
Bombay Electric Pref.	6	6	98	—	6 4
British Columbia Elec. Rly. Pfce.	5	5	43	+ ⅛	11 12 4
do. do. Preferred	Nil	Nil	28½	—½	Nil
do. do. Deferred	Nil	Nil	28	—	Nil
do. do. Deb.	4½	4½	68	+2	7 6 7
Mexico Trams 5 per cent. Bonds	Nil	Nil	37	+4½	Nil
do. 6 per cent. Bonds	Nil	Nil	8½	—	Nil
Mexican Light Common	Nil	Nil	17⅜	—	Nil
do. Pref.	Nil	Nil	29	—	Nil
do. 1st Bonds	Nil	Nil	87	+4½	—
MANUFACTURING COMPANIES.					
Babcock & Wilcox	15	15	3 7/16	—	4 11 0
British Aluminium Ord.	7	10	1 3/16	+ 1/16	6 0 9
British Insulated Ord.	17½	20	3¼	—	6 8 2
British Westinghouse Pref.	7½	7½	22	— 1/16	5 14 4
Callenders	20	20	14½	—	6 18 0
do. 5 Pref.	5	5	4	—	6 5 0
Castner-Kellner	22	20	3 7/16	—	6 1 8
Edison Swan, fully paid	—	—	2¼	—	Nil
do. do. 4 per cent. Deb.	4	4	75¼	—	5 6 0
Electric Construction	7½	7½	1¼	—	6 13 4
Gen. Elec. Pref.	6	6	10⅜	+ ⅛	5 15 8
do. Ord.	10	10	19	— ¼	5 5 3
Henley	25	25	16½	—	7 11 6
do. 4½ Pref.	4½	4½	4	—	5 12 2
India-Rubber	10	10	14⅜	+ ⅛	*3 16 9
Telegraph Con.	20	20	42	+ ¼	*5 14 8

* Dividends paid free of income-tax.

ELECTRIC TRAMWAY AND RAILWAY TRAFFIC RETURNS.

Locality.	Month ended (4 wks.)	Receipts for the month. £	Receipts for the month. £	No. of weeks.	Total to date. £	Total to date. £	Route miles open.	Inc.
Bristol	Dec. 28	22,304	+4,227	52	278,029	+29,488	30·5	..
Cork	„ 31	2,502	+ 381	52	28,965	+ 2,280	9·89	..
Dublin	„ 21	27,458	+2,811	51	343,896	+33,285	54·25	..
Hastings	„ 31	4,116	+ 464	52	63,888	+10,196	19·8	..
Lancashire United	„ 26	9,641	+2,966	51	122,565	+28,122	42	..
Llandudno-Col. Bay	„ 28	929	+ 108	4	929	+ 108	6·5	..
Anglo-Argentine	„ 31	237,702	+9,728	52	2,720,626	+48,221	..	..
Auckland	„ 26	22,308	+ 880	17	92,118	+ 7,892	26·59	..
Calcutta	„ 31	19,386	..	52	..	+ 6	..	..
Kalgoorlie, W.A.	Aug. 1	2,911	..	..	21,065	..	20.5	..
Madras	Sept. 30	4,695	..	31	41,629	+ 3,691	..	..
Montevideo	Dec.	34,025	+2,161	9	65,085	+ 5,817	..	..

MARKET QUOTATIONS.

IT should be remembered, in making use of the figures appearing in the following list, that in some cases the prices are only general, and they may vary according to quantities and other circumstances.

Wednesday, January 16th.

CHEMICALS, &c.	Latest Price.	Fortnight's Inc. or Dec.
a Acid, Oxalic per lb.	1/6	..
a Ammoniac Sal per ton	£75	..
a Ammonia, Muriate (large crystal) „	£58	..
a Bisulphide of Carbon „	£33	..
a Borax „	£88	..
a Copper Sulphate „	£67 10/-	..
a Potash, Chlorate per lb.	3/6	..
a „ Perchlorate „	3/-	..
a Shellac „ per cwt.	£18	..
a Sulphate of Magnesia per ton	£16	..
a Sulphur, Sublimed Flowers „	£85	..
a „ Lump „	£95	..
a Soda, Chlorate per lb.	1/-	1½d. inc.
a „ Crystals per ton	12½/-	..
a Sodium Bichromate, casks per lb.	..	..
METALS, &c.		
c Brass (rolled metal 3' to 12' basis) per lb.	..	..
c „ Tubes (solid drawn) „	..	..
c „ Wire, basis „	..	..
c Copper Tubes (solid drawn) „	1/6½ to 1/7½	..
g „ Bars (best selected) per ton	£147	..
g „ Sheet „	£147	..
g „ Rod „	£147	..
g „ (Electrolytic) Bars „	£125	..
d „ „ Sheets „	£152	..
d „ „ Wire Rods „	£133	..
d „ H.C. Wire per lb.	1/3¾	..
f Ebonite Rod „	3/-	..
f „ Sheet „	2/6	..
n German Silver Wire „	2/3	..
h Gutta-percha, fine „	6/10	..
h India-rubber, Para fine „	2/8	2d. dec.
i Iron Pig (Cleveland warrants) per ton	Nom.	..
l „ Wire, galv. No. 8, P.O. qual. „	£42	..
g Lead, English Pig „	..	..
g Mercury „ per bot.	Nom.	..
e Mica (in original cases) small per lb.	6d. to 8/-	..
e „ „ „ medium „	2/6 to 6/-	..
e „ „ „ large „	7/6 to 14/- & up.	..
d Silicium Bronze Wire per lb.	1/6½	..
r Steel, Magnet, in bars per ton	..	..
g Tin, Block (English) „	..	..
n „ Wire, Nos. 1 to 16 per lb.	4/-	..

Quotations supplied by—

a G. Boor & Co.
c Thos. Bolton & Sons, Ltd.
d Frederick Smith & Co.
e F. Wiggins & Sons.
f India-Rubber, Gutta-Percha and Telegraph Works Co., Ltd.
g James & Shakespeare.
h Edward Till & Co.
i Bolling & Lowe.
l Richard Johnson & Nephew, Ltd.
n P. Ormiston & Sons.
r W. F. Dennis & Co.

Tramway Workers' Wages.—Sir George Askwith, Chief Industrial Commissioner, has been meeting representatives of the Tramway Workers' Union regarding their demand for an increase of war wages by £1 a week, applicable to all such workers throughout the country. There are in this connection something like 35,000 workers concerned, and the demand embraces the whole of the municipal and private tramway undertakings in the country. The tramway workers have received already advances upon pre-war rates of from 8s. to £1 per week.—*Morning Post.*

I.E.E. Dining Arrangements.—In opening the last general meeting of the Institution, the President (Mr. C. H. Wordingham), referring to the proposals which had been made with a view to the members dining together after the meetings, said the Council was favourable to merging the usual Council dinner into a general dinner. There were difficulties in the way of carrying out the proposal at the moment; they had to decide whether they would be leading up to the greater scheme for an engineers' club, or whether by starting in a modest way under the present conditions, that scheme ran the risk of premature failure. It had been decided to consult the general body of members on the matter, and although the Council felt that, on the whole, the time was not opportune, he favoured the proposal, though recognising the difficulties in the way. *Those who wish to attend such dinners are asked to send in their names to the Secretary*, and if sufficient names are received, the experiment will be tried after the next meeting.

The President remarked that it had not been easy to find a suitable place to dine at, but that selection had finally fallen on the Waterloo Tavern, in the Haymarket, which had the advantage of electric cooking, though it was, unfortunately, some distance away, and at the present time they would have to share in the public room.

Football.—At Kingston-on-Thames, on Saturday last, Sopwith Ladies and Sterling Ladies participated in a game of football on behalf of the funds of the Queen Mary Hospital, Roehampton, as the result of which well over £10 was raised. It was a return match between two fine sides, the Ladies from the Sterling Works, Dagenham, maintaining their undefeated record by gaining a two to nil victory after a magnificent struggle, while the home Eleven suffered their second defeat of the season, both at the feet of the Dagenham Ladies.

ELECTRICAL SIGNALLING AND CONTROL ON RAILWAYS.

BY C. M. JACOBS.

(*Abstract of paper read before the* INSTITUTION OF ELECTRICAL ENGINEERS.)

ELECTRICAL methods are generally to be preferred for the operation and control of all the indications required by drivers and signalmen in connection with the two main divisions of railway signalling, viz.:—

1. Block signalling, which has to do with keeping trains runnings on the same line of rails properly spaced; and

2. Interlocking signalling, the function of which is to ensure that the points over which the trains have to pass are properly secured, and to govern movements in and about station yards and junctions generally.

An example of the advantage of electrical methods is to be found in the alteration which has recently been effected in signal aspects in North America, where the three fundamental semaphore indications "Stop," "Proceed with Caution," and "Proceed," are now being given by a single arm. This is possible only by working the signals electrically. Fig. 1 gives a comparison between the British and American

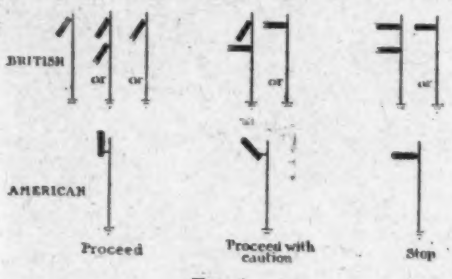


FIG. 1.

signal aspects. The simplicity of the latter will be apparent.

The cardinal principle of railway signalling is that the tendency of failure shall be to cause the "Stop" indication to be exhibited.

It is the business of the signalman to see that the semaphores give correct indications, and where there is any difficulty in his seeing them electric repeaters are provided; but these repeaters are not always as effective as they should be. Mere indication of the position of the signal, however, does not go far enough. In the case of block signalling it should not be possible to place a signal in the "Proceed" position

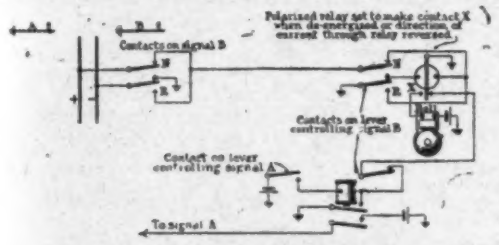

A 1
B 1
Contacts on signal B
Polarised relay set to make contact X when de-energised or direction of current through relay reversed.
Contacts on lever controlling signal B
Contact on lever controlling signal A
To signal A

FIG. 2.

unless at the same time the signal in advance is at "Stop." Fig. 2 shows an arrangement for effecting this, including an audible indicator which sounds when the lever and signal are not in agreement.

Where interlocking signalling is concerned, it is necessary not only to prevent conflicting signals being off together, but also to have the signals in the "Stop" position if the points on the route controlled by the signal are not in their correct position. These safeguards can only be made thoroughly effective by working the signals, and detecting the points, electrically.

In an installation of electric detection of points and signals, a large number of wires have, of necessity, to be run close together, and precautions are required to prevent crosses or earths from causing the improper operation of the detector relays. On this account, and also in order to admit of faults being more easily traced, "common" conductors are to be avoided, while an independent source of energy for each indication circuit is to be preferred.

The McKenzie & Holland and the Westinghouse Power Signal Co.'s arrangement for this, where alternating current with a separate transformer is used for each indication circuit, is shown in fig. 3.

In the event of there being no independent sources of energy, each circuit should get current from independent tappings from the mains. Both these arrangements give continuous control or indication, and both are reasonably free from dangerous failure due to earths or crosses.

Electrical methods of point indication and control are mostly confined to power systems of signalling. They are, however, being introduced in connection with mechanical signalling installations.

Track Circuit.—Signalling movements are further controlled by the presence on the rails of trains and vehicles themselves by means of track circuits.

The track circuit ideal is to detect anything on wheels across the rails. As generally installed, however, with a 4-ohm or 9-ohm relay and a 1-volt battery, a track circuit cannot be depended upon to detect anything which does not put virtually a dead short-circuit across the rails. The result is, that not only is such a track circuit unreliable for taking care of a single vehicle (which in combination with an unclean rail may mean a train shunt of anything up to 5 ohms), but it may occasionally fail to take care of a light engine, or even a complete train.

Track circuits may be divided into three classes:—

(*a*) Those which may be acted upon by complete trains only.

(*b*) Those which may be acted upon by a single vehicle.

(*c*) Facing-point track circuits, which being short have a comparatively high ballast resistance.

In order that these track circuits may be quite reliable, they should be adjusted for minimum train shunts at infinite ballast of 5, 10, and 20 ohms respectively.

The adoption of anything approaching such standards will necessitate a higher ballast resistance, possible perhaps only by sub-division of the track circuit, a higher resistance relay,

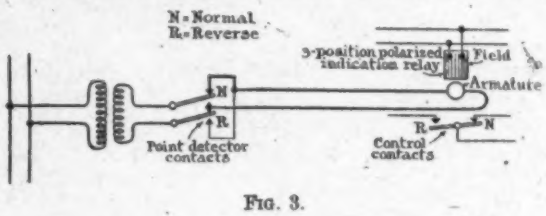


FIG. 3.

a higher battery resistance, and a track battery having a higher electromotive force.

This will be evident from the curves in fig. 4, from which can be obtained all the factors for any track circuit. These curves show the shunt required to reduce the current through the relay to any fraction of the current which would pass through the relay unshunted. The shunt resistances and the battery series resistances are in terms of the relay resistance.

These curves show that the rule that the higher the battery

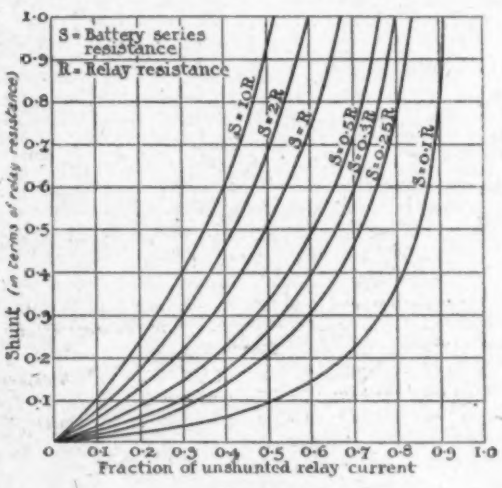


FIG. 4.

series resistance the more sensitive is the relay to shunting, does not completely represent the law of the shunt as applied to track-circuit conditions.

In track circuiting, the problem is to reduce the fraction of the unshunted relay current which passes through the relay when it is shunted by a predetermined minimum ballast resistance (this fraction of the unshunted relay current being known as the pick-up current) to a lower fraction known as the armature release current, which is usually 60 per cent. of the minimum pick-up. The percentage difference between the shunts corresponding to the minimum pick-up and armature release is the same for all curves for the same fractions of unshunted relay current. For efficient shunting, the lower part of the curves should be used; the fraction of unshunted relay current through the relay at minimum ballast should not be greater than 0.2.

Consider the curve in which the battery series resistance is 0.5 of the relay resistance, and let the minimum ballast shunt be 20 ohms and correspond to 0.2 of unshunted relay current, then the shunt at minimum ballast (20 ohms) equals

0.0833 of the relay resistance, which makes the latter 240 ohms.

The standard type of track relay of this resistance requires about 0.01 ampere as the minimum pick-up current, so that the unshunted relay current must be 0.05 ampere, to drive which through the unshunted relay plus the battery series (0.5 relay), *i.e.*, a total of 360 ohms, calls for a battery pressure of 18 volts. If the armature release current is 60 per cent. of the pick-up current it equals 0.12 of the unshunted relay current, the corresponding shunt being, from the curve, 0.045 of the relay resistance, *i.e.*, about 11 ohms.

It is not sufficient to reduce the difference between the pick-up and release properties of the relay, if no regard be had to the value of the shunts which produce the maximum differences in the currents through the relay.

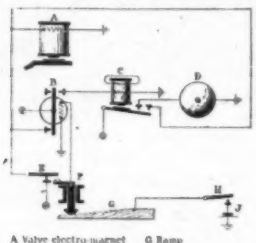

A Valve electro-magnet
B Polarised relay
C Slow-acting relay
D bell
E Switch opened by lifting of shoe
F Shoe
G Ramp
H Switch at signal box
J Battery at
Positive end of engine battery
Mass of engine and earth
Negative end of engine battery connected to mass

FIG. 5.

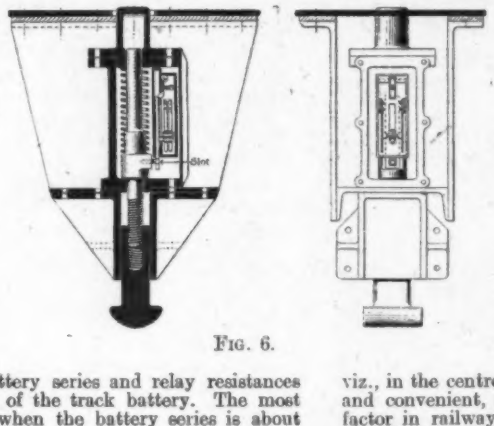


FIG. 6.

The ratio between the battery series and relay resistances only determines the voltage of the track battery. The most economical arrangement is when the battery series is about one-third of the relay resistance.

Automatic Train Control.—Experience has shown it to be desirable that signal control should be exercised directly in the cab of the railway locomotive.

The Great Western Railway has had in use for the last 10 years a fairly extensive installation of automatic train control, a general outline of which will be found in Mr. Acfield's paper* on "Development of Main Line Signalling on Railways." Some further information in regard to it may be of interest.

Safety in railway locomotion is dependent upon a good look-out, and on that account there should be a minimum of interference with the driver consistent with the object sought to be obtained. This minimum is the indication of the distant signal which it is assumed may be missed by the driver. The Great Western system has accordingly been purposely limited to this signal. Further, the control apparatus should be subservient to the driver, who must remain primarily responsible for the running of the train; he may be warned in such a way that his train will be automatically pulled up if he is not taking notice, but when he is alert there must be no question of taking control of the train out of his hands.

The operation of the control on the train must be dependent neither upon a movable appliance on the line (on account of the known weakness of movable appliances, particularly mechanically-operated signals) nor upon the positive making

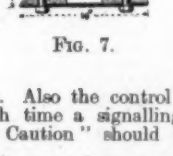


FIG. 7.

of an electric contact. Also the control apparatus should be practically tested each time a signalling position is passed, and "Proceed with Caution" should then be indicated if there is any failure.

Fig. 5 shows the latest arrangement of the cab apparatus. The primary operation is the de-energisation of the electromagnet controlling the valve admitting air to the train pipe. In the case of trains moving at high speeds (80 miles per hour and upwards) over a 40-ft. ramp the period of effective opening of the switch in circuit with the electromagnet may be less than 1/5 second. There has been no difficulty in the armature releasing with this period of interruption. Any difficulty experienced so far has been to maintain an uninterrupted electrical contact with the ramp during the time the switch is open. This has been met by introducing a slow-acting relay, a current impulse through which, due to the operation of the armature of the polarised relay connected with the mass of the contact shoe, is sufficient to cause the armature of the slow-acting relay to keep the switch—during the time it is mechanically open—short-circuited.

* ELECTRICAL REVIEW, April 16th and 23rd, 1915.

The slow-acting relay also controls a bell circuit, so that when the current is picked up from the ramp the bell sounds for a definite period. This is a positive "Proceed" indication, useful in foggy weather and during falling snow, besides showing that the apparatus is in order. In some quarters a positive "Proceed" indication is not considered necessary or desirable, but it may be pointed out that an apparatus which only indicates "Stop," in the absence of this indication implies by inference that the signal is at "Proceed," a questionable method of signalling.

The plunger of the contact shoe (fig. 6) is provided with a spring having an initial compression of 1¼ in. under a load of 250 lb., and a final compression of 3 in. under 530 lb. So strong a spring has been found to be necessary, not so much for obtaining a good electrical contact between the shoe and the ramp, as to keep steady the plunger to which the switch is attached and prevent the latter momentarily opening. By making a slotted connection between the plunger and the switch as shown, instead of directly attaching one to the other, combined with the characteristics of the slow-acting relay, it is found possible to use a weaker spring, thus reducing the wear on the case-hardened face of the shoe. The insulation resistance between the shoe and the mass of the engine averages about 2,000 ohms.

The ramp (fig. 7) has an insulation in wet weather of about 1,000 ohms. The line pressure at the ramp is about 18 volts. It is limited by the difficulty in maintaining primary batteries in country districts, otherwise a higher pressure would be preferable.

The disposition of the shoe and ramp, viz., in the centre of the running rails, is the most practicable and convenient, and this, as safe signalling is an important factor in railway operation, may become a reason favouring the adoption of alternating current for railway electrification.

The efficiency of signalling apparatus is largely limited by the output which can be obtained from primary batteries. There is an enormous number of these cells in use, as each signalling circuit usually has its own individual battery. In large centres it should be more economical, and improved apparatus would result if, in place of individual batteries with limited output, current were obtained from a central battery of accumulators. There are also cases where it might be an advantage to use an alternating-current supply.

A good deal more is generally expected of an electric signalling appliance than of a mechanical one, and rightly so. There is, however, sometimes a tendency to expect what almost amounts to infallibility.

No electrical system of signalling can be absolutely safe or absolutely fool-proof, and unless it be intelligently designed, installed, and maintained, it can only be comparatively safer than mechanical systems or a code of rules. An electrical system cannot eliminate the human element, because it has to be put in and looked after by a human being.

NEW ZEALAND WATER-POWER REPORTS.

THE hydro-electric possibilities of the Dominion of New Zealand have been very much to the front in the last few years. A recent Public Works statement submitted to the House of Representatives shows that at the completion of its second year of working, the maximum load on the Lake Coleridge undertaking reached 6,250 H.P., which is in excess of the rated capacity of the three sets installed there.

Since the completion of the financial year, however, a fourth unit has been put into service, making a total of 8,000 H.P. installed, and a fifth unit of 4,000 H.P., together with material for a pipe line, is also on order, though some delay is anticipated in obtaining it. During the year the Christchurch Tramway Board, and several freezing works and flour mills, have been connected to the system; the feeder lines have been slightly extended, and urgent requests have been received for power from municipalities and others on the route of the Christchurch-Timaru transmission. The demand for power threatens to exceed the capacity of the present machinery, and a contract was to be entered into with the Christchurch Tramway Board and City Council for the use of their steam plant for stand-by purposes.

On the year's working a balance of £7,865 was carried to net revenue account, and there is every indication that the undertaking will meet its interest and depreciation charges during the present year.

During the year considerable progress has been made with the surveys and other preliminary work in connection with the development of hydro-electric works in the North Island. Surveys have been completed for headworks on the Mangahao River, at Arapuni, on the Waikato River, and a survey of the transmission line between Shannon and Wellington has been completed, whilst a survey of a transmission line between Auckland and the Waikato River is in progress.

Investigations have been directed towards determining the best method of providing a general supply of electricity for the North Island. The indications point to the advisabiilty of developing three sources, namely, the Waikato River, Waikaremoana, and the Mangahao in the south. Other water-power sources will, in all probability, be developed in course of time, but these three sources would constitute the principal sources. A start has been made with the work of ascertaining the power requirements in the Wellington district, and a systematic canvass is being made of the power-users and their requirements.

In a report by Mr. E. Parry, the Government electrical engineer, on the hydro-electric development of the North Island, some particulars of the possibilities of the three sources referred to above are given.

Mr. Parry points out that the best scheme is one in which at the outset three sources would be developed for supplying respectively the Auckland district, the Hawke's Bay district, and the Wellington district; these sources would be linked-up.

Waikaremoana is the best source for Hawke's Bay, but as the amount of power is greatly in excess of the requirements, it should be regarded as a supplementary source for supplying the Wellington district.

As regards the Wellington district, investigation has shown the most suitable source of supply for the southern area to be Mangahao river, which rises on Mount Dundas.

By a diversion through the hills for three miles, the fall of 1,040 ft. between the Mangahao and the loop of the Manawatu, near Shannon, is made available. It is proposed to tunnel through the hills into the Tokomaru Valley, there diverting part of the Tokomaru, and then from the Tokomaru Valley through into the Mangaore Valley, where the power station would be situated within three miles of the railway at Shannon. Observations in a dry season show 25,000 H.P. on a 50 per cent. load factor as available, which will be sufficient for the district for some time, and can be supplemented later. The natural extensions of the three transmissions from the three sources will ultimately link them together, so that an additional supply will be available for the Wellington district from the other sources.

In course of time it would be possible to provide additional power from the Taranaki district, where there is more than one promising source.

Instead of installing a stand-by hydro-electric unit, Mr. Parry proposes to utilise the existing steam plant at Wellington to provide against temporary interruptions.

The cost of headworks, power station, and plant for 25,000 H.P. would be at normal prices £420,000, or under £20 per H.P., and this illustrates the advantage of concentrating the power supply for a considerable district in one source; in a smaller development the cost of the hydro-electric works would be excessive.

In the first place it is proposed to run trunk transmissions to Wellington, Palmerston North, Wanganui, and Masterton as chief centres.

The cost of providing the trunk and distributing lines and sub-stations throughout this area would be £580,000, making a total of £1,000,000, which expenditure is at the rate of £40 per H.P.

Capital charges at 7½ per cent. work out at £3 per H.P.-year; the annual cost of maintenance and operation would amount to £25,000 per annum, or the equivalent of £1 per H.P.-year, thus making £4 per H.P.-year for both charges. Experience shows that in Christchurch this revenue can be secured without difficulty, even where economical fuel plants are already installed.

Mr. Parry considers that the Waikaremoana scheme should be made dependent upon the construction of the Napier-Gisborne Railway, which would open up a better road for the transmissions. The Auckland and Wellington schemes should proceed simultaneously.

Reporting on the development of the Waikato River at the Arapuni Gorge, about 18 miles from Hora-Hora (for supply to the Auckland district), Mr. Parry says this source has much in its favour; the capital cost of the ultimate development would be remarkably low, but it would require the construction of a dam 146 ft. high.

Neither the Kaituna River nor the Waikato River at Aratiatia Rapids compares favourably with Arapuni as regards capital cost per H.P.

Mr. Ellis, of Hamilton, in discussing the matter, says the Arapuni site would develop 120,000 H.P., or even 150,000 H.P., its drawback being that under the present proposal to put in a 30,000-H.P. plant, the latter would have to carry proportionately heavier capital charges, bringing the cost up to the same as the Mangahao plant. If, however, 60,000 H.P. could be developed, the all-in cost per H.P.-year would be £2 17s. 6d., for 365 days of 24 hours.

In the discussion on the Public Works estimates, it was stated that the Auckland area would in a brief time absorb 40,000 H.P.

An Italian Trade Opening.—According to the *Board of Trade Journal*, the Acting British Consul at Turin states that a local engineer seeks the representation of United Kingdom manufacturers of el trical machinery and hydraulic plant.

ELECTRICAL MANUFACTURING IN AUSTRALIA.

WE are indebted to the *Sydney Morning Herald* for the following extracts from an interesting address delivered on November 9th by Mr. WM. CORIN, the retiring president of the Electrical Association. The speaker said there was no doubt that the war had given an impetus to the manufacture in Australia of electrical apparatus, and that orders had been lodged with makers in the Commonwealth which would otherwise have been placed abroad. It need scarcely be said that had the firms been prepared they would have received a tremendous volume of work, but at present they were unable to quote for anything large. For this they could not be blamed, for no one in Australia expected the war to come, or, if it came, to last as long as it had, but in other respects local enterprise had failed in connection with some of the simplest of electrical manufactures. Nothing, for example, could exceed the simplicity of the electrical furnace. Had the arrangement projected between the Queensland Government and a Sydney syndicate in 1906 been carried into effect, all the carbide of calcium required for the Commonwealth would now be manufactured with power from the Barron Falls. Imports of this material for the nine years from the date of his report to the Queensland Government on this matter, *i.e.*, from January, 1907, to June, 1916 (omitting six months not included in the return), had totalled 92,186 tons, valued in the Customs returns at £1,160,312. Whereas the price of manufacture in 1907 would have been approximately £9 per ton, and probably £11 now, the market price of carbide had risen from about £13 to £30 to-day, and even at this price it was scarcely obtainable. During the same nine years there had been imported into the Commonwealth caustic soda, which could also be manufactured as an electrolytic product, totalling 37,848 tons, valued at £451,881. Tasmania had now made a start with the manufacture of carbide, as well as with other similar industries, but beyond a small experimental carbide furnace tried some years ago in Sydney, the only serious attempt at electrothermic manufacture in New South Wales that he was aware of was the manufacture of high-grade steel by the Australian Electric Steel Co. at Alexandria. This company had laid down a two-ton furnace, turning out six tons of steel a day. The venture had been so successful that the company was duplicating the plant. They used 2,000,000 units of electrical energy per annum, and were making special steel for axles and tires, chrome-steel for rolls for steel rolling mills, manganese steel, and other high-grade steels. There was a distinct field for electric manufacture in this direction, and in the development in New South Wales of the large electrochemical and electrothermic industries, requiring a steady supply of power, it was probable that eventually the water powers of the State would be brought into operation in spite of the fact that coal was comparatively cheap.

"Soon after I arrived in Australia," Mr. Corin went on to say, "learning of the large copper production, I naively inquired why it should be sent away, and not manufactured here. The reply was immediate, that the whole of the copper market was controlled from Germany, and that there was no possibility of manufactured copper being produced in Australia. The Prime Minister has been instrumental in relieving the country of this incubus, with the result that a start has already been made to produce all classes of manufactured copper at Port Kembla, and before long all the copper required for internal use will be manufactured in the Commonwealth. Steel and iron are already available here, and their production can be increased to any extent. Further, all classes of insulating materials (mica, insulating oils and gums, &c.) are to be found in Australia. Why, therefore, should not all the turbines, generators, motors, and electrical machinery generally required for the development of the Commonwealth be manufactured within it? When the war is over active competition from established works outside Australia will be intensified owing to many manufacturing countries making a bid for Australian trade. Australia will not be ready for some years to manufacture on a large scale, and the only way of meeting this competition and fostering local manufacture, if Australia is to produce her own machinery, will be either by a heavy protective duty or by reduction in the cost of labour.

"Timid unionism, in its fears for the result of untrammelled development, has in the past dictated that in cases, even for work which could be carried out by boys, none but skilled men should be employed. Surely unionism will learn from the object-lessons now before it, and will put its shoulder to the wheel for the benefit of Australia. Again, the limitation of apprentices is unjustifiable. If there be abuse of the apprentice system, let it be made the subject of legal enactment. There should be always a surplus of learners employed at any trade, to allow not only for those who do not turn out well or who fail to continue at it, but also to prepare for the expansion which must come if Australia is to progress as a self-contained manufacturing country. The present system is killing the possibility of expansion."

GAS FIRING BOILERS.

Mr. T. M. Hunter's paper on "Gas Firing Boilers" was discussed at a meeting of the Scottish Local Section of the Institution of Electrical Engineers on December 11th.

Mr. J. H. R. Kemnal (Glasgow) said it was generally conceded that there was very little advantage in producing gas merely for the sake of firing boilers. It could only be made to pay if by-products were recovered, and if the value of the by-products reached a certain figure. One must bear in mind that blast-furnace gas was a by-product; there usually was such a surplus of gas at blast-furnaces, that the highest possible efficiency was not a necessity to the successful working of the plant, and the introduction of refinements to attain a high percentage efficiency would not be justified. He was prepared to prove from experience that the water-tube boiler had a great advantage over the Lancashire boiler for utilising blast-furnace gas; the three-flue Lancashire boiler was now little used, whereas with water-tube boilers improvements had been effected, and they could get rid of dust by steam blowers. The hardening of flue dust on the tubes was caused by initial neglect. His experience was at variance with that of Mr. Hunter, and he thought it would be a great mistake to design a boiler on Yarrow lines for utilising blast-furnace gas. A point in connection with blast-furnace gas was that for every 100 therms of utilisable gas they had to carry a great deal more unutilisable gas, and that was a reason why large passages were essential. In Babcock and Wilcox boilers, by placing the tubes at more than the ordinary pitch they had got considerably improved results. He recalled an instance of washing blast-furnace gas where an elaborate installation for this purpose was put in. The results obtained were less with the washed than with the unwashed gas, mainly due, he thought, to a great deal of heat being lost in washing. Another method was using gas which approached lighting gas in value, and in this connection he had been investigating results reported as having been got by the Bonecourt boiler. He had no means of disproving the figures published as to the total efficiency of this boiler, but he had considerable doubt as to the results being exactly as described, and was convinced that it was impracticable except in a few cases. One of the points of impracticability was that it could not be made in units above a certain size. He did not think it would be capable of producing 20,000 lb. of steam per hour, which to-day was looked on as a small unit. As an application of the burning of gas under theoretical conditions it was ideal. As to the burning of blast-furnace gas under boilers, one could not say that one particular design of furnace was better than another. In the utilisation of gas they could not apply any particular practice to all cases. The investigation of each individual case was essential.

Mr. F. Anslow said it was correct to state that gas could be utilised at furnaces and give all the steam power required, but while that was so up till a certain period, it was not so to-day. The introduction of ammonia recovery plants had meant the use of much steam power, and the increase of other power plant had resulted in the recovery of almost all recoverable waste heat. He did not think the introduction of specially installed producer gas plants for steam raising would be particularly profitable. Under present conditions it was extremely difficult to form a definite opinion on the relationship between the price of coal and that of by-products.

Mr. W. M. Selvey pointed out that while they could not vary the Lancashire boiler, the water-tube boiler enabled them to design it, so far as the division of surface was concerned, to meet any conceivable conditions. What they were out for was to get the biggest output possible for a given capital expenditure for the desired purpose. The question of utilising waste heat was going to become one of great national importance, and they might yet see it run on lines parallel to gas-engine stations.

Mr. Hunter, in the course of his reply, said that if they were working with clean gas they could use economisers in a different way than they did in working with coal firing, as there was no dust to accumulate. He would never dream of trying to fire a Yarrow boiler with uncleaned gas, because they could not get at the passages to clean them. He was of opinion, however, that under certain conditions a high efficiency with clean gas could be obtained from that type of boiler. He agreed with Mr. Kemnal that there was no one combustion arrangement which could be applied to different cases. He would not say that one particular boiler might suit a particular plant without full information of requirements. While he was up against existing boilers, he did not think it would be a commercial proposition to pull out Lancashires and install water tubes. The water-tube boiler had the pull in burning uncleaned blast-furnace gas, but it paid to clean the gas for a Lancashire.

NEW PATENTS APPLIED FOR, 1917.

(NOT YET PUBLISHED.)

Compiled expressly for this journal by Messrs. W. P. Thompson & Co., Electric Patent Agents, 285, High Holborn, London, W.C., and at Liverpool and Bradford.

31. "Electric heating elements." L. G. Caunter. January 2nd.
32. "Electric arc for curative and therapeutical purposes." H. C. Ross. January 2nd.
34. "Sparking plugs." W. G. Kent & F. Martin. January 2nd.
36. "Systems for amplification of small currents." British Thomson-Houston Co. (General Electric Co., U.S.A.) January 2nd.
57. "Accumulating and utilising electric energy in the form of recovered heat." R. Arno. January 2nd.
71. "Alternating-current motors." A. C. Bell & T. R. Bell. January 2nd.
79. "Arrangement for securing electric contact in overhead trolleys for tramcars, &c." A. C. Franklin. January 2nd.
112. "Electric couplings." R. W. Whitley. January 2nd.
120. "Vacuum tubes." G. A. Beauvais. January 2nd. (France, August 1st, 1917.)
121. "Vacuum tubes." G. A. Beauvais. January 2nd. (France, August 4th, 1917.)
139. "Semi-automatic telephone systems." L. Polinkowsky & Western Electric Co. January 2nd.
169. "Electric circulating water heaters." Simplex Conduits, Ltd., and L. M. Waterhouse. January 3rd.
180. "Sparking-plug pin." F. E. Moore. January 3rd.
183. "Electric lampholders." B. J. Grigsby. January 3rd.
210. "Wire attaching device for sparking plugs of explosive motors." A. Jouveau & C. Tournoud. January 3rd. (France, August 11th, 1916.)
213. "Electric welding." E. Jones, A. Ramsdale & J. P. Toole. January 4th.
244. "Electric conductor." H. George & J. Herbert. January 4th. (France, April 16th, 1917.)
245. "Electric transformers." F. E. Berry. January 4th.
248. "Electric protective apparatus for alternating currents." H. Pearce. January 4th.
261. "Free-release circuit breakers." Allmanna Svenska Elektriska Aktiebolaget & G. Seligman. January 4th.
262. "Electric syrens." Allmanna Svenska Elektriska Aktiebolaget and W. H. Petersen. January 4th.
283. "Attachable hook or holder for electric torch lamps, &c." M. H. Goldstone. January 5th.
290. "Process for separating electro-deposited metals from their matrix." S. O. Cowper-Coles. January 5th.
306. "Automatic time switches for controlling X-ray exposures, &c." Newton & Wright. January 5th.

PUBLISHED SPECIFICATIONS.

The numbers in parentheses are those under which the specifications will be printed and abridged, and all subsequent proceedings will be taken.

1916.

17,709. Electrical Instrument for Indicating Instantaneous Pressures or Currents. J. T. Irwin. December 9th, 1916. (111,885.)

17,749. Wireless Telegraphy Transmitters. Marconi's Wireless Telegraph Co. & W. S. Entwistle. December 9th, 1916. (111,887.)

17,803. Telephone Memo-filing Receptacle. S. M. Brydges. December 11th, 1916. (111,891.)

17,929. Electrical Apparatus having Windings. British Electric Transformer Co. & J. Goodman. December 13th, 1916. (111,899.)

17,930. Protective Means for Electrical Apparatus having Windings. British Electric Transformer Co, & J. Goodman. December 13th, 1916. (111,900.)

17,937. High-frequency Alternators. Soc. Francaise Radio-Electrique. September 16th, 1915. (102,738.)

18,208. Dynamo-electric Machinery. A. H. Neuland. December 19th, 1916. (111,915.)

18,423. Current-saving Devices for Electric Welding. C. Roulland. December 22nd, 1916. (111,925.)

1917.

18. Electric Cables. British Insulated & Helsby Cables, Ltd., & J. Brotherton. January 2nd, 1917. (111,929.)

313. Telephone System. Aktieselskabet Elektrisk Bureau. January 15th, 1916. (103,482.)

468. Sparking Plugs for Internal-combustion Engines and the like. R. F. Stiller, A. M. Patton & C. Hurst, Ltd. January 10th, 1917. (111,936.)

752. Single-stroke Electric Bells. G. Henderson. January 13th, 1916. (103,487.)

1,080. Electric Terminals or Connections. H. C. Bell. January 22nd, 1917. (111,942.)

1,748. Electric Bells. J. Davis & Son and W. H. Davis. February 3rd, 1917. (111,948.)

4,557. Engine Starter. V. Benedix. March 29th, 1917. (111,967.)

5,254. Electric Current Interrupters. K. Trosdahl. April 13th, 1917. (111,968.)

8,001. Shade Carriers for Electric Lights. C. G. M. Bennett. June 4th, 1917. (111,978.)

11,465. Interrupter for Electric Circuits. R. Bosh (firm of). August 9th, 1917. (Addition to 25,880/11.) (111,988.)

12,054. Machine Switching Telephone Systems. Western Electric Co. (Western Electric Co., U.S.A.) August 22nd, 1917. (111,991.)

12,351. Time-limit Electric Circuit Breakers. Akt. Ges. Brown, Boveri et Cie. February 20th, 1917. (Addition to 14,406/15.) (111,993.)

14,588. Tool for Clinching Terminals for Electric and other Couplings. Ross, Courtney & Co. and J. A. Ross. October 9th, 1917. (112,009.)

The A.S.E. and Man Power.—In introducing the new Military Service Act in the House of Commons on Monday, Sir Auckland Geddes referred to the most regrettable circumstance that the Amalgamated Society of Engineers had refused to take part in the conferences which he had been holding with the Trade Unions respecting measures to be taken to withdraw young men from the essential industries for military service. We cannot believe that workers in the engineering industries who have rendered such necessary service to the Allied cause during the past year or two will fail that cause at the present crisis. Sir Auckland has the support and sympathy of the nation in his proposals for carrying out the intentions of the War Cabinet, and it would be deplorable to think that engineers, of all men, played into the hands of the enemy. History would record the fact to their eternal disgrace.